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A common methodology for the collection of pesticide usage statistics within agriculture and horticulture

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Preface

The European Commission's interest in statistics on pesticide use is not new. As early as the 1990's it set up a task force which included representatives from the United Kingdom, Sweden, France and the Netherlands, whose task was - together with Eurostat - to share their experience of surveys on pesticide use and to draw up guidelines for the collection of usage statistics within the Member States. At the request of the Organisation for Economic Co-operation and Development (OECD), this task force was expanded to include a representative of the United States. The task force considered methods of collection already in use in the European Union and in the member countries of the OECD, and discussed at length the minimum data requirements that a survey should meet.

This cooperation led to the joint publication by Eurostat and the OECD of the first "Guidelines for the Collection of Pesticide Usage Statistics within Agriculture and Horticulture" (THOMAS, 1989).

Since then, there has been a growing interest – particularly on the part of the EU and OECD member countries – in monitoring and reducing the risks related to the use of pesticides. The Member States, the European Commission and the OECD have conducted a number of studies aimed at establishing indicators to monitor these risks. Based on these studies, in 2007 the EU financed a research project as part of the 6th Framework Programme, with the aim of establishing a set of "HArmonised environmental Indicators for pesticide Risk" (HAIR).

Around the same time, in July 2006, as part of the Sixth Environment Action Programme ("6EAP"), the Commission adopted its Thematic Strategy on the Sustainable Use of Pesticides, which was set out in a Communication to the European Parliament and to the Council (COM(2006) 372 final) and proposed the adoption of a Directive of the European Parliament and of the Council establishing a framework for Community action to achieve a sustainable use of pesticides (COM(2006) 373 final).

In parallel with the framework Directive, the Commission proposed to the European Parliament and to the Council to adopt a Regulation concerning statistics on plant protection products (COM(2006) 778 final) to ensure that comparable data are collected in all the Member States, thereby making it possible to calculate harmonised risk indicators and to measure the progress made towards a more sustainable use of plant protection products throughout the Community.

In preparation for the adoption of this Regulation, the Commission funded several pilot actions on the collection of data on pesticide use. In particular, two successive rounds of pilot projects were financed in 2005 and 2007 in the new EU Member States and in the candidate countries via the Phare Programme and the Transition Facility/ multi-beneficiary statistical cooperation programmes (ADAS, 2005; ASA, 2008; ICON 2008). These pilot actions, which were based on the methodology described in the original guidelines, demonstrated the value of adopting a common approach.

Considering that the initial guidelines were still relevant and might be of great interest in the initial stages of the implementation of the Regulation, once adopted, it was thought that it would be useful to refresh the guidelines and illustrate them with the results of the pilot actions in the form of a case-study.

As a result, this methodology and working paper are largely based on the initial guidelines published in 1989 by the Eurostat Pesticide Statistics Task Force under the leadership of Mr Miles R. Thomas. They are complemented by explanatory notes prepared by the consultants in charge of the coordination of the two successive rounds of pilot surveys - ADAS International in the UK and ASA-ICON Institutes in Germany. Lastly, they are illustrated with the main results of the pilot surveys on wheat carried out in 2007 in 11 new Member States and candidate countries. All reports and documents on which this paper is based can be consulted on the Commission Circa website at the following address: http://circa.europa.eu/Public/irc/dsis/pip/library?l=/indicators_pesticides

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1.1 Types of pesticide statistics

There are two types of statistics on pesticides:

- **Sales statistics**, which are usually considered as being relatively simple to collect and fairly inexpensive. However, comparisons of sales data over time are, at best, a crude indicator of change. Moreover, sales statistics can give rise to confidentiality issues and restrictions on the release and use of data for commercial reasons. When they are collected from existing administrative sources (declarations by producers or sellers), sales data are rarely available at the active level and contain no information about the crop, timing, regional variation in use, dose applied, number of applications to the crop or percentage of crop treated. The dividing lines between agriculture, amenity, industry, etc. in terms of use are often blurred. All these reasons, plus the fact that the definition of "pesticide" varies from country to country, make comparability across countries difficult. Therefore, for most applications which are covered later in the section on the "Role of statistics", sales statistics alone are virtually useless.

- **Usage statistics** in a broad sense cover all kinds of data on the actual use of pesticides by farmers and growers. They can be gathered through statistically valid samples of farms grossed up to give national estimates, or through compulsory returns by all users. Their accuracy depends mainly on the sample size, which is usually limited by the resources available, the mix of the population by region, farm size, education, etc., the truthfulness of respondents, and the quality of the interviews (visits by qualified staff versus unqualified staff or postal surveys; questionnaire on 'average' treatments or field-by-field treatments, etc.

1.2 Role of usage statistics

Collecting a reliable set of usage statistics has value in many areas of research, legislation and agricultural support, and should not be regarded simply as a statistical exercise in its own right. Within the EU Member States, for instance in Great Britain, pesticide use has been surveyed cyclically on all crops for over 30 years and the usefulness and availability of the data generated far outweigh their cost of collection.

Areas of use fall into eight main categories, described below; the first two of these are the most important for the European Commission (EUROSTAT) and the OECD:

Provision of annual usage estimates

In their simplest form, usage statistics provide information on national and regional levels of pesticide inputs to individual crops. Thus, information should be available on the total amount of any particular pesticide used annually, together with the areas treated and the range of crops to which it has been applied. Additionally, information on the total inputs of all pesticides to any one crop would also be available. Both of these can be broken down to provide a seasonal profile of use, as dates of application should also be available. Such data are required at several levels:

- **At a national level, to inform government of the current status of pesticide use**

Following a number of recent press reports of "pesticide scares" concerning carcinogenic, neurological or other undesirable effects of specific pesticides, it is vital that ministers have up-to-date information on pesticide usage. This includes data on the product range to which they belong, the crops on which they are used and the extent to which those crops are treated – all of which ultimately yields information on the likely exposure of the population to the purported hazard. Without these data, governments could find themselves in the embarrassing position of being unable to defend the results of their own legislation. Indeed, it is written into most national legislations that the government must monitor the post-registration use of pesticides. Data are also freely passed on to universities, NGOs such as Greenpeace, Friends of the Earth and the World Wide Fund for Nature, and also to members of the general public.

In addition, detailed statistics on pesticide use will become essential tools to develop and monitor the national action plan to be put in place in each Member State in the framework of the Thematic Strategy on the sustainable use of pesticides.

- **Within the EU**

At EU level, the need for harmonised data on pesticide use has been clearly recognised. In particular, harmonised and comparable Community statistics on pesticide use are essential for the development and monitoring of Community legislation and policies in the context of the Thematic Strategy on the Sustainable Use of Pesticides.

- **Within the OECD**

The Pesticide Forum of the OECD, and in particular the Risk Reduction Group, have expressed a need for reliable usage statistics.

- **Internationally**

The FAO is attempting to compile annual statistics across all countries pursuant to Article 1 (1) of the FAO Constitution, which stipulates that "the Organisation shall compile, analyse and disseminate information relating to nutrition, food and agriculture".

Monitoring changes over time

Once the regular collection of usage statistics has been established, it is possible to monitor changes over time in use on particular crops, or of particular pesticides. These changes may be the result of several factors, some or all of which may interact to give annual variations in use:

- **Annual differences in the weather**, influencing the range of pest, disease and weed problems requiring control, or affecting the ability of the farmer to apply the pesticide under suitable conditions

- **The introduction of new molecules** which may replace older, less active pesticides, and may also be applied at much lower rates per hectare

- **Changes in the price of, or level of support to, crops,** thereby altering margins and making the use of pesticides more or less economic.

Environmental protection

Reliable data on usage are critical for the development of indicators of the effects of pesticides on the environment, and data sets over time are needed in order to monitor the effects that policy changes may have on that impact. Pesticide risk and environmental indicators, in particular, need time series (i.e. not only sales data) in order to examine changes, regular surveys, data crop by crop and related realistic usage.

Section 3 of this report develops the themes of risk and environmental impact indicators for pesticides in greater detail.

Consumer protection: providing information for residue monitoring programmes

Usage data on individual crops are essential for the planning of monitoring programmes for residue analysis of fresh fruit and vegetables.

- **Where new monitoring programmes are being launched,** usage data will illustrate the range of pesticides currently used on the crops to be monitored and allow the analytical follow-up to be tailored to focus on only those pesticides that are likely to be encountered. For instance, usage data have provided the foundation for the development of residue monitoring follow-up for a wide range of home-grown produce within the UK in order to monitor compliance with Maximum Residue Levels (MRLs).

- **Where unusual or unexpected residues are found,** usage data can confirm the results or point to alternative methods to corroborate or invalidate the findings. For example, an analysis of plums using HPLC with UV diode array detection indicated that 50% of samples contained residues of diflubenzuron, whereas usage data suggested that only 5% of the crop had been treated. These survey results prompted an alternative analysis by LC-MS, which revealed that suspected residues were artefacts. In contrast, residues of chlorothalonil in lettuce – a non-approved use within the UK– were corroborated by survey data where such misuse had been encountered in the field. EU-wide surveys would allow Member States to tailor their monitoring programmes for imported produce as well as home-grown foodstuffs.

- **Contribution to studies of dietary risk:** data on the percentage of crop treated within the country, on the number and rate of applications, and on harvest intervals, are vital for the probabilistic risk assessments used to refine exposure models.

Operator protection

Data on farmers' actual use of pesticides may be examined to see where current practices can be improved or optimised. Specific surveys on work rates for spray operators can provide useful information on average area treated per day and range, average number of treatments per season and range, and amount of product handled per operation. When used as part of a deterministic approach, such data are ideal for probabilistic risk assessment to refine operator exposure models. Better data on methods of application used will also improve risk analysis for workers and likely exposure estimates in prediction models for operator exposure.

For example, in Great Britain, the comprehensive database of farmer practice with regard to fungicide and insecticide use on winter wheat is being examined to identify where farmers may be using pesticide programmes inappropriately. This examination is focusing in particular on under-utilisation of varietal resistance or inappropriately timed pesticide applications. Furthermore, there would appear to be some scope for reducing pesticide applications in certain circumstances. It is hoped that those areas where clear savings can be made will be identified and targeted for further advice, in an effort to reduce inputs of pesticides to those crops. The technique should be applicable to many crops.

Monitoring the potential movement of pesticides into water

Data on pesticide usage can be used to assist in the monitoring of pesticide contamination in surface and ground waters. For example, the EU seeks to protect drinking water and groundwater through legislation, leading to the widespread monitoring of pesticide residues so as to ensure compliance with these directives. In Great Britain, for instance, usage data are used within a complex geographical information system, which includes maps of soil and groundwater, rivers and other waterways and water abstraction points. This is overlaid with current cropping and pesticide usage patterns, both geographical and seasonal, and - together with a database of pesticide properties and models of movement through different soils - it is used to predict the likely appearance of pesticides at abstraction points, in order to facilitate the monitoring of pesticides in water. By so doing, it is hoped to avoid unnecessary monitoring for pesticides which are unlikely to appear at a specific point or time within a given water body. It is important to note, however, that such methods can only be used to guide the monitoring process rather than be a substitute for it.

Policy advice during review programmes

An essential part of the review process of a pesticide, which is currently underway for all existing pesticides within the EU (http://ec.europa.eu/food/plant), is the knowledge of the local and national uses and requirements for that pesticide. If monitoring suggests that growers are unable to compete without a particular pesticide, and no alternatives are available, this must be borne in mind during its review. Reliable usage data are fundamental to such appraisals and are an appropriate means of quantifying the effect of withdrawal. Alternatively, the demonstrated lack of use of a particular pesticide, coupled with the availability and uptake of safer or more benign alternatives, may hasten the withdrawal of a pesticide.

Furthermore, in the USA, in response to the Food Quality Protection Act (1996), the Environmental Protection Agency has developed a so-called “Risk Cup” whereby the total area of a crop is assumed to be treated at full label-recommended rate. This is then applied to the tolerance level, and the exposure risk is calculated. If the risk cup is not full, further registration is allowed. If the cup is full, on the other hand, exposure risk is recalculated using actual estimates of area treated and rates of use from survey data. Without such data, the continued approval of products may be significantly affected.

Providing information as part of the approval process for new pesticides

During the approval of new active substances, usage data may provide a clear indication of the likely uptake of a new pesticide, based on a knowledge of which pesticide(s) it is likely to replace and the current extent of their use. Furthermore, with such data it is possible to evaluate likely operator exposure, as realistic work rates can be derived from the data collected, such as average field size, area sprayed per operator per day, amount of pesticide handled per day, and so on. All these factors are vital in developing models of predicted operator exposure.

1.3 Methods of data collection

When drafting the first guidelines, Eurostat’s pesticide task force considered methods of collection that were already in use in the EU and in OECD member countries. Five broad methodologies requiring differing levels of input and organisation were examined.
During the discussions with the Member States on the drafting of the Regulation concerning statistics on plant protection products, the need to allow the Member States enough flexibility in the choice of the methodology was stressed. Countries should thus select the methodology most suitable to their resourcing and requirements, amongst the following:

- **Personal visits** to a representative sample of farmers and growers to collect information on what they have used;
- **Telephone interviews** with a representative sample of farmers and growers;
- **Postal or e-mail surveys** of a representative sample of farmers and growers;
- **Compulsory returns** of pesticide use from all farmers and growers

Personal visits

Personal visits have long been used in a number of countries, such as the United Kingdom (UK), France, Sweden and the United States of America. Information is collected on the pesticides applied to specific crops over the previous growing season or year from a statistically derived, representative sample of farmers and growers. Such surveys have the advantage of accuracy, particularly where trained personnel are used, as the surveyor can scrutinise all the potential uses which might have occurred, ensuring that the grower does not omit or forget anything important. For example, in the worst case, many growers consider pesticides to include only insecticides (i.e. those which kill insect pests) and may not include other groups such as fungicides, growth regulators or desiccants. Other areas which are often not considered by growers include seed treatments and molluscicides applied at drilling. Pre-drilling and pre- and post-harvest treatments to the soil are also important and are often overlooked by farmers if no specific questions are asked about them.

A further advantage of personal visits is that they enable all the relevant crops to be surveyed on a single farm without over-complicating the survey. To cover only one crop or field at each visit would result in many more visits having to be undertaken in order to derive a statistically valid sample.

As with any survey, it is vital to have a well-structured form on which to record the data, and farmers should be given prior notice of a visit, to allow them time to gather together their records and information.

Telephone interviews

Telephone surveys have been used, particularly in Sweden, to reduce the cost of the survey programme. These surveys are similar in structure to personal interviews, but they avoid the time and cost of travel. However, they should not be over-complicated and it would be unwise to attempt to cover all the cropping on a farm in a single call. To further simplify the interview, such surveys may cover only the largest field of each crop grown on the selected farm.

The calls should be preceded by an information letter, giving some indication of the form the interview will take. It is also important to have trained personnel making the calls, using a structured questionnaire.

In Sweden, comparative studies conducted in 1990 and 1992 showed that the differences in results between personal visits and telephone interviews are statistically insignificant given that the telephone interviews are performed by trained personnel, as long as the information required is not over-complex.

Postal or e-mail surveys

Postal surveys have been used in the Netherlands to obtain information on pesticide use for specific crops grown on selected farms. Postal surveys are considerably less expensive than visit surveys, but can usually expect a return of up to only 30%. However, experience in the Netherlands suggests that this does not bias the sample in any way towards those farmers who are more conscientious or are more likely to carry out “good farming practice”. Survey numbers can be increased to account for the reduction in participation in order to reach the desired number of responses. For example, if results from 1,000 farms are needed and the response rate is known to be no better than 28%, then the initial sample should comprise a minimum of 3,570 farms.

Postal surveys need to be simpler than surveys undertaken by personal visits or telephone interviews; this is exemplified by the surveys undertaken in the Netherlands, where only one crop per farm is surveyed. However, this enables survey forms to be tailored to each crop, and statistical validity is maintained simply by increasing the sample size.

Postal surveys can be open to abuse, in that respondents may only include what they want the enquirer to know, thereby overlooking or omitting known misuse. Furthermore, these surveys are particularly open to misinterpretation, with respondents potentially leaving out specific uses that they might think are excluded from the survey, or even disregarding part of the survey. However, just as visit and telephone surveys require trained personnel, the staff involved in checking the returned questionnaires will also need to be experienced in understanding what is likely to be used on a crop at a particular time. Further checks may also be included in the questionnaire and, as with other survey methods, many error-checking routines can be built into the data entry programmes and any obvious omissions can be followed up and checked with the grower.

Additionally, postal surveys can be structured in such a way that questionnaires are sent out several times during the year after important periods during the husbandry of the crop when pesticide applications are likely to have occurred. This will remind the grower to fill in the form at a time when the information required is fresh in his memory and reduces the burden of filling in a form with all the details at the end of the growing year.

In the Netherlands, before the survey begins, farmers are asked by post whether they still grow the crop covered by the survey, and whether they will take part in the survey. If they agree, at the beginning of each month they are sent a questionnaire which is tailored to that crop and which reflects the practices likely to be undertaken during the following month.

Each survey covers all of the most important crops, but surveys are only undertaken every two or three years. This has the advantage of providing a complete picture of use of any one active substance, while lessening the burden on individual farmers. Farmers who participated in the previous survey are also excluded from selection for the next survey.

Postal surveys can be replaced by or complemented with e-mail or web-form surveys.

Compulsory returns of spraying records from all users of pesticides

When the guidelines were drafted, the only known example of compulsory returns from all pesticide users of all their spraying activities was in the US State of California. These returns took the form of monthly returns by post. The overheads involved in handling the vast amount of data generated by such a comprehensive system were very high and the administration and computing were complicated to set up initially. However, the Californian experience appears to illustrate the usefulness of such a comprehensive database, once it is established. This methodology may well be particularly appropriate to small countries or for specific crops, as it is organised for the production of fruit and vegetables in the Belgian producers' association (Veilingen) or by organic farming certification companies.

It should be noted that Regulation (EC) No 852/2004 of the European Parliament and of the Council of 29 April 2004 on the hygiene of foodstuffs (Annex I, part A, point 9) establishes an obligation for food business operators producing or harvesting plant products to keep records on any use of pesticides, but does not make it compulsory to return these records.

Sales statistics as an alternative or a complement to usage data

Collection of sales data can be used as a substitute for a survey of usage data. One of the obvious advantages is that sales data are much cheaper to collect, and collection can therefore be performed annually. However, it is an advantage if such sales statistics are regularly followed up by a survey on usage to verify and clarify sales data.

Where countries do not immediately have the resources to undertake surveys of pesticide use using one of the methods outlined above, some useful information can be obtained from the collation of sales statistics, although this is in no way a proper substitute for statistically reliable surveys. Some of the advantages and disadvantages are listed below, together with a description of the process currently used in Sweden, where it is compulsory for manufacturers to return sales figures.

- **Advantages**

There are advantages to using sales statistics as a basis for providing simple statistics on pesticide use. They are relatively inexpensive, since they are generally compiled by agrochemical organisations, or the state, directly from company returns. In some Member States, collection of sales data is a statutory requirement. The data are theoretically accurate, as chemical companies are likely to know with some degree of precision how much of each product they have sold. Sales statistics are therefore quick to produce, as companies should be able to supply quarterly returns, or - at worst - annual figures, which can be processed within weeks of receipt. The data may be used as a check on usage statistics when sold quantities differ. Thus, statistics on sold quantities may be used to adjust and improve surveys on use of pesticides.

The data may be used to provide estimates for years when surveys are not undertaken.

- **Disadvantages**

Where agrochemical organisations are involved in the collation of data, unless all the companies within a country are members of that organisation, the statistics will represent only a part of total sales. For example, the British Agrochemicals Association comprises approximately 30 major pesticide producers, but there are nearly 200 chemical companies that have pesticides registered for use in the UK. In the Netherlands, Nefyto (the Dutch Foundation of Phytopharmacy) has published yearly sales figures since 1984, but represents only 90% of the whole producer population.
However, since 1993, the Dutch government has also received figures from non-members. The same situation is seen at EU level, where the European Crop Protection Association (ECPA) covers only part of the European market.

Where products are unique to individual companies, commercially sensitive sales data are unlikely to be released at product level. This, together with the work involved in separating all individual active substances, may result in some aggregation of data. For example, all fungicides or organophosphates may be grouped *etc.*, thereby masking the use of specific active substances or usage on individual crops.

Sales figures do not accurately represent usage if there is any lag within the chain from sales by producer through distributor to end-user, and these lags may be exacerbated by any stock-piling within the distribution network or by users. Data from Great Britain would suggest, however, that most growers buy in only what they intend to use, but the statistics for a single year may be distorted if farmers are hoarding pesticides, e.g. as a hedge against expected price changes. Stocking at the user end of the chain occurs infrequently and only among the smaller producers of minor horticultural crops, particularly where annual requirements are less than pack size.
Most chemicals are not specific to single crops, so sales data are of no use for anything more sophisticated than total usage figures.

Sales figures often provide little, if any, information on regional differences in use. Total sales may include sales to sectors outside agriculture, for example weed control in industry or on public areas (roads, pavements, parks *etc.*), sports grounds, homes and gardens.

Data on weights sold cannot be converted accurately into area treated. For example, many farmers in Great Britain invariably apply pesticides at well below the recommended rate, leading to a gross underestimation of areas treated if they were to be calculated by taking the weight applied and simply dividing it by the recommended rate. Furthermore, experience in the UK indicates that farmer uptake of reduced rates seems to vary from region to region and is definitely influenced by enterprise size, thereby complicating any attempt to predict the area treated.

Finally, unless sales data have been collected using the same classification system for pesticides, they will be impossible to interpret meaningfully.

1.4 Defining the crops to be sampled

These guidelines are designed to allow assessment of pesticide usage within the broadest range of agriculture and horticulture, including usage in food storage practice. For these purposes, agricultural crops include all the major arable crops, grassland and fodder crops. Horticultural crops include fruit, vegetables, protected crops, hops, mushrooms, bulbs, flowers and hardy nursery stock.

These sectors should **not** include use of amateur products in homes and gardens, or use of professional products by industry, in amenity situations, on roads, railways or other sectors of the transport industry. They are also not intended to cover use of wood preservatives, anti-fouling paints or pesticides used in public hygiene situations, such as insect control in buildings *etc*.

Ideally, all agricultural and horticultural sectors should be surveyed, as this will not only account for all pesticide use - thereby satisfying the requirements listed in the introduction - but also because it is more often in the minor sectors or uses where problems may occur. However, this may be too expensive for some countries, and crops should be selected which represent the majority of pesticide use, both in absolute terms and in terms of rates of application.

It can be seen from Table1a that the most important crops in Great Britain - which represent, for example, 90% of the area grown (sum of ranks 1 to 7) - account for only 73% of the area treated (Table 1b – sum of ranks 1, 2, 4, 7, 8 & 11) and only 40% of the weight applied (Table 1c sum of ranks 2, 4, 7, 8, 9 & 10). Moreover, they include none of the crops for which the highest rates of application are found (Table 1d), while the 15 crops receiving the highest rates of application account for 45% of the total weight applied.

Therefore, a sensible selection should be made within each country of the crops which represent those most commonly grown, plus those receiving the most treatments, by area treated, weight applied and rate of application.

It is sometimes within those crops subjected to the highest rates of pesticide application that problems resulting from pesticide use may occur, and as they tend to have high inputs they may belong to the politically most interesting group, for which large reductions in usage may be stipulated.

For example, from the data presented in Tables 1a-d, it would be sensible to include at least the following crops:

Crop	Importance derived from Table:			
Permanent grass	1a		1c	
Wheat	1a	1b	1c	
Grass < 5 years old	1a	1b	1c	
Winter barley	1a	1b	1c	
Set-aside	1a	1b	1c	
Spring barley	1a	1b	1c	
Oilseed rape		1b	1c	
Sugar beet		1b	1c	
Ware potatoes		1b		1d
Peas		1b	1c	
Beans		1b	1c	
Mushrooms				1d
Edible protected crops				1d
Seed potatoes				1d

Rough grazing is omitted because it is not listed as important in any of the tables on pesticide use (Tables 1b-d). Marrows and flower crops are omitted because of the very small areas grown. For flower crops, this would not apply in the case of the Netherlands, where they form a significant part of national horticulture.

Table 1.1a Variation in importance of crop by area grown (UK)

Rank	Crop	Area grown (ha)	% of total area grown	Cumulative % of area grown
1	Permanent grass	4,714,794	31	31
2	Rough grazing	4,286,369	28	59
3	Wheat	1,989,417	13	72
4	Grass < 5 years old	1,093,699	7	79
5	Set aside	608,100	4	83
6	Winter barley	541,769	4	87
7	Spring barley	530,777	3	90
8	Oilseed rape	356,780	2	93
9	Sugar beet	169,148	1	94
10	Beans	164,184	1	95
11	Ware potatoes	138,004	1	96
12	Oats	123,205	1	97
13	Maize	120,996	1	97
14	Peas (dry harvested)	84,765	1	98
15	Peas (fresh for frozen)	39,998	0	98

Source: ADAS 2005

Table 1.1b Variation in importance of crop by area treated[1] (UK)

Rank	Crop	Area treated (ha)	% of total area treated	Cumulative % of area treated
1	Wheat	23,756,331	51	51
2	Winter barley	4,972,425	11	62
3	Spring barley	3,170,090	7	68
4	Oilseed rape	2,976,534	6	75
5	Ware potatoes	2,325,625	5	80
6	Sugar beet	2,024,354	4	84
7	Set aside	1,134,978	2	87
8	Field beans	990,557	2	89
9	Oats	766,852	2	90
10	Peas (dry harvested)	720,824	2	92
11	Maize	446,196	1	93
12	Grass < 5 years old	293,082	1	93
13	Permanent grass	283,836	1	94
14	Peas (fresh for frozen)	249,614	1	95
15	Seed potatoes	248,648	1	95

Source: ADAS 2005

Table 1.1c Variation in importance of crop by weight of pesticide applied (UK)

Rank	Crop	Weight applied (t)	% of total weight applied	Cumulative % of weight applied
1	Ware potatoes	9,202	30	30
2	Wheat	8,695	28	58
3	Seed potatoes	3,767	12	71
4	Winter barley	2,060	7	77
5	Oilseed rape	846	3	80
6	Spring barley	801	3	83
7	Sugar beet	629	2	85
8	Set aside	564	2	87
9	Field beans	510	2	88
10	Peas (dry harvested)	332	1	89
11	Permanent grass	293	1	90
12	Oats	263	1	91
13	Maize	234	1	92
14	Grass < 5 years old	211	1	93
15	Onion - dry	190	1	93

Source: ADAS 2005

[1] *Note that the area treated for a crop may exceed the area grown, as this is the sum of all applications made to that crop (e.g. one hectare of wheat sprayed six times has an area treated of 6 spray hectares.*

Table 1.1d Variation in importance of crop by average rate of pesticide use (UK)

Rank	Crop	Average application rate (kg/ha)	% of total weight applied	Cumulative % of weight applied
1	Mushrooms	120	< 0.1	< 1
2	Pinks	42	< 0.1	< 1
3	Carnation	40	< 0.1	< 1
4	Flowers, foliage (glass)	34	< 0.1	1
5	Bean - runner	19	0.1	1
6	Alstroemeria	16	< 0.1	1
7	Seed potatoes	15	12.3	13
8	Asparagus	12	0.2	13
9	Lettuce (protected)	10	0.1	13
10	Chrysanthemums (glass)	8	0.1	13
11	Celery (protected)	7	< 0.1	13
12	Flowers for cutting	4	< 0.1	13
13	Ware potatoes	4	30.0	43
14	Horseradish	3	< 0.1	43
15	Strawberry	3	0.5	44

Source: ADAS 2005

1.5 Frequency of surveys

Although surveys should ideally be undertaken annually, it is currently unrealistic to expect all countries to embark upon annual surveys of all crops. Even in Great Britain, where monitoring is perhaps at its most sophisticated, arable crops - which represent around 86-90% of usage - are only surveyed every two years, while all other crops are surveyed every four years. It is recommended that, if annual surveys are not possible, important crops (as outlined above) should be surveyed at least biennially, although an annual programme should be followed for those crops where usage is greatest. The most limiting factor is resource availability, and the various countries currently undertaking surveys have established different cycles to satisfy their own requirements.

At the time these guidelines were being prepared, Sweden had biannual surveys of all important crops.

In the USA, major arable crops were surveyed annually because the government was concerned to monitor how quickly new or alternative products replace the chemicals that are being phased out. Fruit and vegetable crops were surveyed biennially on alternate years.

In Great Britain, arable crops are surveyed at least biennially because of the speed of introduction of new active substances, giving rise to a rapidly changing market of use. Furthermore, chemicals have a two-year period of wind-down following partial revocation, designed to allow safe disposal through normal channels of supply, sales and use. In order to monitor this effectively, it would be unwise to have a survey interval greater than the average wind-down period. The introduction of new products into the horticultural industry, however, is much slower. Owing to a lack of resources horticultural surveys cannot be repeated more frequently than once every four years. Whilst this is not ideal, it is accommodated somewhat by the much slower introduction and turnover of new products.

In the Netherlands, surveys have been undertaken every three years and, while all major crops are included in each survey, the work involved means that they cannot be repeated more frequently than this.
Where surveys are not undertaken annually, it should be borne in mind that differences in weather patterns from year to year may have a greater effect on usage than changes due to other reasons, particularly on crops where change is very conservative. Until a sequence of surveys have been undertaken it would be unwise to explain changes between two surveys as the result of any single factor.

1.6 Essential Data requirements

The level of complexity of data collection is dependent on the resources available to undertake the survey. The more data collected, the more areas outlined in the introduction will be covered. However, there are a minimum number of parameters that need to be collected in order to make any survey worthwhile.

The following data are considered essential to collect for each crop to be surveyed; they include the crop and its grown area, the product applied and its timing and rate of application or amount used, and the area treated. Other data, which may be collected if resources allow, are listed at the end of this section.

Crop

A record of the crop to which pesticides have been applied is clearly vital to any realistic assessment of pesticide use. This should take the form of the crop name as defined by the Community Farm Structure Survey (or the Crop Statistics Regulation). It should additionally mention whether this was a winter or spring crop, if this is not already part of the census definition (*e.g.* winter or spring wheat, barley, oilseed rape, linseed, *etc*.).

It would be unrealistic to attempt to survey pesticide use on all crops within a single survey, and the limits of the survey with regard to the crops to be covered need to be clearly defined at the outset. Some apparently similar crops, or developmental stages of a crop, may be best covered in different surveys. For example, a survey of pesticide use on orchard crops may exclude trees being grown in a nursery, as these may be covered in an alternative survey of all nursery stock. Similarly, peas grown for harvesting fresh for the frozen pea market, or carrots, which may be grown on arable farms in arable rotations, may be omitted from a survey of arable crops as they would be covered under a survey of vegetable crops. Peas for harvesting dry may be considered as combinable crops and would fit best in a survey of arable crops.

It is also necessary to define which developmental stages of a crop will be considered by which survey, so as to avoid “double counting” of pesticide applications and thereby inflating the actual amount of pesticide used on a crop. Difficulties like this may arise with crops such as lettuces and brassicas, which may be raised from seed under glass as small plants, often with quite high inputs of pesticide, then sold on to be planted out, either under glass or outside. The seedling production stage and any applications to the subsequent crop if planted under glass may be covered by a survey of usage on protected crops, and care must be taken to avoid any double counting of use. However, applications made to the crop once planted outdoors would be covered by a survey of outdoor vegetable crops, and any seedling treatments should not be included in this category if they are covered by a survey of protected crops.

Therefore, the survey must clearly define the crops that are to be included and this, in part, may also be defined by the census data available. It is relatively easy to multiply up sample data to a known total area of a crop grown, but difficulties arise where no census data exist for a crop, although this is usually only the case for minor crops.

- **A specific case: crop replacement**

For different reasons (frost, poor germination, etc.) a crop may have to be replaced by another one (for instance, winter wheat by spring wheat). In such a case, the treatments given before sowing or to destroy the remaining part of the crop (total herbicide treatment) should be taken into account, as being associated either to the main crop (in this case, the winter wheat) or to the replacement crop (in this case, the spring wheat). Usually they will be attributed to the main crop but - whatever the case - they should not be overlooked.

Area grown

On each surveyed farm, the area grown of each crop to be surveyed must be recorded. This will be used to gross up data on pesticide inputs to give national estimates of usage. Problems may arise with multiple cropping. Where the principal interest is in data for water quality studies, clearly any multiple cropping (e.g. taking several harvests from one field of alfalfa) will not influence the fact that the area grown is equal to the area planted. However, for studies directed more specifically at food quality, the number of crops on a single piece of land must be taken into consideration. For example, for six crops of lettuce grown on one field in a year, the area treated should be taken as six times the area of the field. Failure to do this would result in the sum of all treatments on all six crops being attributed to just one crop of lettuce.

Product

The product actually used should be collected, wherever possible. This is vital in order to establish the active substance(s) being applied, and also its/their formulation. Different formulations of the same pesticide may have different impacts on human health or the environment, despite containing the same active substance(s).

In most instances, growers may only know what they have used by its product name, which is ideal, but alternatively they may have known what they wanted to use only by its constituent active substance(s), and may not have kept a record of the actual product used. This is often the case for chemicals such as cypermethrin, which is well known to farmers by its active substance and is frequently a constituent part of the product name in the UK, thereby allowing farmers to consider it generically (*e.g.* “Manufacturer’s name” Cypermethrin 10).

Care must be taken with prefixes and suffixes to product names, where small changes in a name can often denote very different constituents. For example, within the UK, Alto 100 SL, Alto Eco, Alto Elite, Alto Combi and Alto Major all contain cyproconazole, but at different rates and with widely differing added fungicides (see: Table 1.2). It is therefore important to collect the full name with as much detail as possible.

To collect only “Alto” as the product used would lead to considerable confusion and misrepresentation.

Table 1.2 Example of variations in constituent active substances in products with similar names

Name	Active substance(s)
Alto 100 SL	Cyproconazole
Alto Eco	Cyproconazole + Mancozeb
Alto Elite	Cyproconazole + Chlorothalonil
Alto	Combi Cyproconazole + Carbendazim
Alto Major	Cyproconazole + Tridemorph

- **Seed treatment**

Seed treatments may not be known by the farmer and it may be necessary to obtain this information from the merchant or supplier. A distinction between own treatment and bought seeds can be made, but the principle is the same. The quantity of seed used per hectare of crop will determine the quantity of product of treatment applied to the crop. If self-treated, the composition of the seed treatment should be taken from the farmer's own administration. If purchased, the information must be either on the seed label or, if not available, it can be obtained from the wholesaler, retailer or producer. Usually information about the seed variety and the supplier is sufficient to identify the treatment applied (as this information is easily retrieved by the plant protection services).

Amount used or rate of application

The rate of application is crucial to estimating the total amount of pesticide used and, likewise, the total amount used and the area treated can be used to derive the rate of application. Either is acceptable. Experience in Great Britain has shown that it is not sufficient to assume that the farmer/grower has applied the chemical at the label-recommended rate. The average rate for applications of fungicide products to wheat in 1996 in Great Britain was, in fact, just over half of the rate recommended on the label. Assumptions that label rates had been adhered to would therefore have overestimated use by almost 100%.

The grower's actual rate of application to the crop should be recorded, as litres or kilograms of product per hectare. Where the grower is unsure of the rate, a record of the actual amount used and the area treated will clearly allow for subsequent calculation of rate. It would also be acceptable to record the grower's known level of application, for example "½ or ¾ of label recommended rate".

This will also allow the rate to be calculated from a knowledge of the pesticide's own label recommendations.

- **Seed treatment**

In the case of seed treatments (which can be systematic in some crops), the quantity of seed used and the type of seed treatment will determine the quantity of product applied to the crop. In order to determine the quantity of product applied through seed treatments, it is essential to collect the information about sowing density (number or kg of seeds per hectare) or to apply standard coefficients (average regional sowing density).

Area treated

The area treated with each pesticide application should be recorded, as this may not necessarily coincide exactly with the area of crop grown. Part-field treatments to control specific localised weed or pest problems, and applications only to headlands or to all parts of the field except headlands, are amongst the reasons why the whole of a crop may not be treated. Additionally, there may be enforced buffer zones applied to certain pesticides that prevent application within a certain distance of a watercourse, hedge or other boundary.

Where spot treatment has occurred, for instance in grassland to control small patches of pernicious weeds, the grower should estimate the area treated, if it is not already recorded. Where this is not possible, the area should be calculated from the amount used and the application rate. Note that when the area treated for a given crop is added up, it will often exceed the area of crop grown. Care must be taken over definitions, for which no accepted standards have yet been established.

However, in order to define more precisely what is being referred to, a set of definitions is proposed in Section 1.17.

Timing (date of application)

The date of application of each pesticide should be recorded. Timing is perhaps the least essential of the above data requirements, but recording the date can prove useful for many aspects of analysis. A record of timing will make it easier to quantify the number of sprays applied to a crop, because without timing, or some record of tank-mixing, it would not be possible to separate sprays applied on separate occasions from those applied together. More accurate data on the timing of applications help with many of the aspects outlined in the section in the Introduction on the role of usage statistics. Timing data are particularly relevant to monitoring potential movement into water, monitoring farmer practice with regard to ineffective or illegal timings, providing information on harvest interval for residue monitoring, and in environmental studies, where there may be critical periods during the year affecting the impact on non-target species.

Biological control methods

Biological control methods include preparations of fungal, viral and bacterial agents, as well as the introduction of natural predators and parasites. Biological control methods should be regarded in the same way as pesticide applications. Changes in the use of these methods, and potential increases in use at the expense of conventional pesticides, will be of importance to schemes which aim to monitor the conversion from current practices to methods of integrated pest control.

The area over which an introduction has been made (area of crop "treated") should be recorded for each introduction, to provide a record of the number of treatments made. There would seem to be little to be gained from recording the number or amount of agents introduced (*e.g.* five *Encarsia* per m^2), but this may be relevant in some situations.

1.7 Additional information

The above guidelines outline the minimum data requirements considered necessary in order to obtain valuable information from a survey – essentially what is being used, where, when and in what quantities. Whilst they are not highlighted as essential, many aspects of the agronomy of crops may provide useful further information on pesticide use or assist in the analysis of differences in use between crops. Countries should consider which aspects of the demands outlined in the introductory section are of most relevance to their situation and consider collecting any further information from the list below which may enhance those data, where resources permit.

Crop type

In this context, crop type may provide a fuller definition of the crop beyond that broken down within a census orFarm Structure survey definition, or as "winter" or "spring", as previously defined under "Crop". For example, the definition may include the words "culinary", "dessert" or "cider" for apples and pears.

Crop type is an important parameter to collect, as pesticide inputs may differ significantly between different crop types. In Great Britain, for example, inputs to many areas of cider apples are often low, or zero, compared to apples grown for dessert consumption. Furthermore, dessert apples often have higher inputs than culinary apples in Great Britain, while the Cox variety frequently has higher inputs than other dessert varieties.

Other important distinctions may exist between crops grown for processing and those grown for sale on the fresh market, *e.g.* blackcurrants, strawberries, and potatoes, which can be grown for seed, ware (human consumption) or industrial use. This distinction should be made if such crops are not separated at the census level or in the farm structure survey, because pesticide use can differ markedly between the different types.

Variety

In addition to crop type, there is merit in recording the variety or cultivar of the crop grown where this may be expected to influence pesticide inputs. Crops such as wheat, with known variability in disease resistance, may have very different fungicide regimes applied to different cultivars within the same farm. By collecting information on the variety of crop grown, this variation can be examined, as growers may not be exploiting varietal resistance to the full. Such knowledge can give clear indications about where advisory work and extension services may suggest changes in practice, which can lead to a reduction or optimisation of pesticide inputs.

Crop stage

A record of the developmental stage of the crop may not be necessary if this is implicit from the timing of the application or the crop definition. However, it may be necessary to record crop stage under certain circumstances. For example, in the UK, pesticides approved for use on any crop for human or animal consumption may be applied to nursery fruit trees, vines prior to final planting out, bushes, canes and non-fruiting strawberries, provided that any fruit harvested within one year is destroyed. It is therefore important to record that the crop stage was preproduction during the nursery or maiden phase, since many applications would be non-approved to the fruiting crop. If these crops are already defined as nursery stock, then crop stage is unimportant.

Similarly, the crop stage may be taken as “before planting” or “after harvest” so as to include pesticide applications made to land associated with the production of a crop but not necessarily applied to that crop. Again, these may appear as non-approved uses if the crop stage is not recorded.

Desiccant or herbicide applications to ripened crops, such as glyphosate applications to wheat prior to harvest, should be recorded as “before harvest” to distinguish them from applications which would clearly appear to have killed the crop had they been applied earlier.

Applications of insecticides to vegetables, for example chlorpyrifos, will alter considerably as crop stage develops. Drenching of compost during propagation of brassicas to control soil pests will be at much higher rates per unit area than later foliar applications against aphids or caterpillars.

Formulation and method of application

A record of the formulation will often be implicit in the product name (*e.g.* granular, seed treatment, *etc*.), but the method of application of the pesticide(s) should be noted, and the level of detail is dependent on the resources available within each county. In its simplest form, this needs to be no more detailed than “ground spray”, “aerial application”, *etc*. Within granular applications, however, it is important to know whether the granules were broadcast or incorporated, as this may well have significant environmental implications.

If resources allow, more precise information on the type of spraying equipment used may have considerable implications for operator or bystander safety, drift, environmental contamination *etc.*

Thus, it would be worth recording whether the applications were made by knapsack, air-assisted sprayer, ultra-low volume equipment, *etc.*

The range of methods of application available differs widely within the different commodities surveyed, with options such as fogging, misting and smokes being common within protected crops.
A comprehensive listing of the principal methods of application that are recognised and defined within the range of commodities surveyed in Great Britain is given in Appendix V.

Spray round

In order to estimate the number of times a crop has been treated, it is necessary to maintain some record of the spray round within which the product has been applied. A spray round may be defined as a single treatment to the crop to apply pesticide(s), and in the case of cereals, for example, may involve the application of a complex tank-mix of chemicals including fungicides, herbicides, growth regulators and insecticides within a single treatment.

Collecting such data will allow subsequent consideration of the average number of times a crop has been treated with a fungicide, insecticide *etc.*, and give a clear indication of what products are frequently being tank-mixed together. Thus, the first pesticide application should be marked as spray round 1. For many annual crops, this may well be any seed treatment applied to the crop, and so as to allow an estimate of the proportion of crop not treated with a seed treatment there is merit in recording this first treatment as "Not treated" with a seed treatment where none was used.

All the products mixed together within one application should be linked using the same spray round number, which increases by one for each subsequent application made to the crop.

Granular applications should be given a unique spray round number, even if they were applied at the same time as a sprayer passed over the crop, which is sometimes the case. As they were not physically mixed in with the other chemicals applied, and also require a separate method of application, it is not feasible to include them in with an accompanying spray.

An example of the use of spray round to link chemicals applied together is given in Table 1.3.

Table 1.3 Layout of data to illustrate the use of spray round to link chemicals applied together

Date	Product	Method of application	Spray round
12/9/96	Seed treatment A	Seed treatment	1
15/10/96	Herbicide B	Ground spray	2
15/10/96	Herbicide C	Ground spray	2
12/3/97	Herbicide D	Ground spray	3
12/3/97	Fungicide E	Ground spray	3
12/3/97	Fungicide F	Ground spray	3
12/3/97	Growth regulator G	Ground spray	3
12/3/97	Molluscicide H	Granular broadcast	4

Target species or reason for use

Where possible, the grower's perceived reason for use should be recorded. This may be a target species, pest or weed(s), disease or range of diseases or, in the case of growth regulators, for reasons such as straw shortening, fruit setting, fruit thinning or ripening. The reason given may not always appear appropriate but should be recorded, as this may give a further indication of where pesticides may be being used inappropriately. With this knowledge, there may be scope for better advice or labelling, thereby reducing inputs.

Crop rotation

Crop rotation was not identified as an essential element by the task force, but it was highlighted as important during the OECD workshop on Pesticide Risk Indicators in Copenhagen. It is more related to pest management outside pesticide use, but may have implications for monitoring the development of integrated crop management. Crop rotation will indirectly affect pesticide use, as previous cropping history can significantly influence the spectrum of weeds, pests and diseases likely to be encountered in the crop. Changes in soil fertility may also influence the requirement for applications of growth regulator. Recording the previous cropping history of the land on which the surveyed crop is being grown is therefore the best way of monitoring crop rotation. Studies of disease levels in major arable crops in England & Wales (wheat, winter barley and oilseed rape) have shown an effect of previous crop, an effect of the length of break from the current crop and an effect of continuous cropping of up to three years or more. This would therefore indicate a need to record previous crop for at least three years prior to the current crop.

Drilling method

The availability of treated seed to birds and mammals will be influenced in part by the method of drilling, which will also influence the sowing rate. Differences in drilling method – e.g. direct, broadcast, broadcast and ploughed in, precision, conventional *etc*. – may be recorded.

Sowing date & harvest date

Sowing date is a useful parameter to record because it can influence crop development, and thus the need for and timing of pesticide applications. Harvest date may have implications for applications made within the harvest interval for some crop/pesticide combinations. It is particularly important in countries like the USA, where the development of the "risk cup" approach to registration may be influenced by the probability of finding residues in edible crops because of incorrectly observed harvest intervals.

Both of these parameters may also be helpful in explaining odd or non-approved uses if application dates prove to be outside the cropping period, i.e. before planting or after harvest applications.

Crop covers

Use of crop covers may have implications for monitoring the uptake of integrated pest management techniques. For vegetable crops, crop covers are sometimes used to protect crops from the weather and pests. These could take the form of polythene or fleece and may influence, reduce or negate the requirement for certain pesticide applications – for example, organophosphate insecticides to control carrot fly in carrots and parsnips. The type and period of cover should be noted.

Mulches

Mulches of organic material, such as straw or peat, or artificial mulches in black, white or other coloured polythene are often used. These are particularly important in soft fruit production, but may also be used on other crops. Although they reduce the need for herbicide applications, such covers may exacerbate pest problems, such as vine weevil in strawberries. A note should be made of the presence or absence of mulch and its type.

Age of crop

This factor may be unnecessary where crop definition already distinguishes between crops of different ages, for example maiden *vs.* fruiting tress. Where this is not the case, for perennial crops such as fruit trees, olives, *etc.* and temperate crops such as rhubarb, cane fruit, bush fruit and strawberries, the age of the crop may influence pesticide inputs, and some age structure that is suitable for the individual crop and its pesticide programmes should be devised and recorded. For example, strawberry crops should be recorded as: maiden, one, two or three years old. Fruit trees may be classed as: maiden, less than 5 years old and 5 or more years old, or using some system which would distinguish between gross differences in use as crops age, if this is the case. Grassland in England & Wales is classified for census purposes as (1) sown within 5 years of the survey; (2) all other grassland except rough grazing and (3) rough grazing. For pesticide usage purposes, the "within 5 years" category is further broken down into areas sown within 12 months of the survey and those over 12 months old. This allows consideration of seed treatments and molluscicide and herbicide applications during the establishment year, which may be much higher than on established grass.

Although such surveys are outside the scope of these guidelines, countries may wish to consider the value of such surveys as a means of obtaining additional information on pesticides, such as handling practice, use of personal protective clothing, spraying machinery maintenance and calibration procedures, spraying machinery filling and washing practices, *etc.*

1.8 Sample design

In sampling, it is important that the data of the survey represent the required totals within accepted error margins which are justified in the sampling design. In the design, the number of samples to be surveyed and their identification are determined in such a way that the resulting data represent the population and their use can be defended.

It is not the aim of this section to define the sampling method to be used in each country, as this is best achieved by using each country's own statistical offices. However, it is important to ensure that the data collected are statistically sound for each crop. The methodology already in use within some EU Member States is given for guidance purposes.

Setting up a sample is not a standard routine and several issues need to be determined, e.g.:

- The target population: for instance, the total area sown with wheat in a region/country;
- The sampled population: the part of the target population that is accessible and available for sampling and ideally the same as the target population;
- The sampling frame: the list of all possible sampling units for which the sample can be selected.

The basis of a sound sample is a knowledge of the true population. Without an adequate census of the entire farming community, there would be little point in trying to undertake a survey of pesticide use, as there would not be enough data on which to gross up the sample to produce national estimates.

Given the resources available, sample selection should aim for the largest sample that is practically feasible.

Regional differences in climate, pest and disease pressure, farming intensity and general farm practice often lead to significant regional differences in pesticide use, even on the same crop. Thus, sampling should initially be stratified by region.

Here, the concept of the sampling unit should be specified:

- In most cases the sampling unit is a holding (farm) and the list of all possible sampling units is typically the list of all holdings growing the crop(s) covered by the survey. Sampling frames are therefore list frames made available through existing registers or census lists (Farm Register, FSS, FADN, IACS, Crop Surveys, etc.).
- In specific cases, the sampling unit can be a geographic feature (a physical segment – for example, a plot –, a squared segment or a point): this is typical of the area frames approach (used in France). The list of all possible units is then all the points or segments where the specified crop(s) is(are) grown.

Where the sampling unit is the whole farm, if farm size is believed to influence the degree of pesticide use, samples should be stratified by farm size group within the region. This approach has several advantages. Firstly, farming practice - and particularly the use of pesticides - may vary considerably with enterprise size. In Great Britain, farmers with enterprises of less than 50 ha are known to be less likely to use pesticides at reduced rates than farmers with enterprises over 250 ha. In the Netherlands, however, there appears to be no difference in use across farm sizes, and stratification by size is not considered necessary. Farms may therefore be selected at random within any regional stratification.

Where the sampling unit is a single crop on a farm, farms should be selected at random within any regional stratification for each crop to be surveyed.

Where the sampling unit is a field of a particular crop, a random sample of fields should be selected so that the probability of selecting a particular field is directly proportional to the total area planted of the crop to be surveyed, within any regional stratification.

Where the sampling unit is a field, the fields should be selected at random, within any regional stratification.

Sampling unit versus observation unit

One of the essential parameters to be identified in pesticide surveys, besides the quantity of product, is the area treated. As explained in the previous section, it is very important to identify the area treated with each product as precisely as possible. Therefore, when the sampling unit is the farm, it can be useful to collect the information at the level of the field (considered as an observation unit).

In the most common case (list frame), it should be extremely clear that the sampling unit (which will be used as the basis for the calculation of regional-national totals) will always be the holding (farm), but observations are to be made at the level of each field (it can also be the main field or groups of fields if treatments are similar across the fields) and are aggregated at the level of the holding.

For area frames, the sampling unit should be equivalent to the observation unit, though significantly different processes are involved depending on the type of feature (a point, a physical segment or geometric segments can be used as sampling unit).

1.9 Establishing a regional breakdown

Stratification by region is inevitable, for example where soil types vary regionally, which may particularly influence pesticide use and may be essential where there are regional variations in pesticide legislation (e.g. the USA).

Stratification by region should aim to divide the country into areas with similar agro-environmental characteristics, and such a breakdown may already be used in many countries. Within the EU, there is also the regional breakdown used by the Farm Accountancy Data Network (FADN), which, for example, recognises 21 distinct regions in Italy, 22 in France and 17 in Spain *etc.*
Where this breakdown is not detailed enough, other systems may be used. For example, FADN recognises Scotland as one region, whereas in terms of land use Scotland has been divided into 11 clear regions, which are used for the purposes of surveying pesticide use within Scotland.

In England and Wales, six regions are used, corresponding to the original Ministry of Agriculture administrative regions, which have a degree of homogeneity with regard to land use and climate, and consequent pest and disease pressures. This breakdown provides slightly more detail than the four regions used by FADN: whereas the Netherlands have 14 agricultural areas, Sweden is divided into 102 yield districts. While it may be necessary to select the sample and collect data regionally, it is not necessary to present data for every region. However, this approach does allow usage to be broken down more easily into areas which may also map catchments, for example.

1.10 Establishing farm size groups

Pesticide usage on the same crop may vary with farm size. For example, larger farms may be managed by more highly trained personnel who are prepared to apply pesticides at reduced rates when pest pressure is low, or who are more aware of newer products or methods of pest control. Where size grouping is thought to be necessary, it should aim to divide farms into size groups such that the total area of holdings in each group is roughly equal. In Great Britain, farms are generally grouped into five classes. This enables the government to select the right number of farms in each group for visits, and avoid visiting large numbers of small farms which make little contribution to total pesticide use, or visiting too few large farms which contribute significantly. For example, groupings of arable farms in England & Wales were adjusted to give the most even distribution of areas across size groups, as shown in Table 1.4.

Table 1.4 Size grouping, numbers of farms and total areas for arable farms in England & Wales

SIZE GROUP	< 50 HA	50-100 HA	100-150 HA	150-250 HA	> 250 HA	TOTAL
Area of farms	687,118	710,797	550,187	719,954	940,621	3,608,679
% by area	19	20	15	20	26	100
Number of farms	39,629	9,972	4,502	3,786	2,367	60,256

Using this breakdown, it is easy to divide farms by simple size groups, designed to apportion approximately 20% of the total arable area to each group. The 100-150 ha group falls below this ideal area, while the largest size group (> 250 ha) accounts for a larger than ideal area. Adjustments could be made to the size of the larger groups to offset this, *e.g.* by experimenting with size groups of 100-180 ha, 180-280 ha and > 280 ha.

Alternatively, size grouping may be based on the European economic-size unit which is an elaborate size unit based on the cultivated area and price derived for the crop in question.

1.11 Establishing the sample

The aim of sampling should be to select farms from a representative number within each regional (and size group) cell. Within very small cells, a minimum of two farms should be sampled to ensure statistical validity. As a guide, the numbers of farms and/or fields surveyed for each crop within countries already undertaking surveys are listed in Table 1.5.

Table 1.5 Sample sizes and populations in some countries currently conducting surveys

Crop	No of farms visited	No of farms growing crop	No of fields surveyed
Great Britain			
Winter wheat	864	43,960	7,701
Winter barley	710	35,388	2,766
Set-aside	875	39,208	2,417
Spring barley	517	28,909	2,043
Oilseed rape	516	16,770	1,761
Sugar beet	190	9,543	768
Ware potatoes	201	16,918	590
Peas	127	4,546	286
Beans	182	6,218	494
Mushrooms	90	221	288 (crops)
Edible protected crops	250	2,937	1,184 (crops)
Seed potatoes	45	1,355	77
Sweden *	3,775	74,500	3,775
USA			
Corn	1,757		1,757
Cotton	1,189		1,189
Potatoes	676		676
Soybeans	2,657		2,657
Winter wheat	1,516		1,516
Spring wheat	308		308
Durum wheat	122		122
Selected fruit crops	7,204		7,204
Selected vegetable crops	6,281		6,281

* *N.B.* The number of farms visited is not the same as the number of farms in the sample selected. Since the frame is updated only once a year, it contains a small number of non-active farms.

1.12 Producing national estimates

Essentially, a statistically valid random sample will give an average use per hectare for each pesticide on each crop (within each region). Total use is obtained by multiplying this average by the total area grown (within each region).

Where farms have additionally been stratified by size, and assuming that a sound sampling procedure has been followed, sample data may be grossed up to produce national estimates which correct for over- or under-sampling of a crop within any region. A grossing-up factor can be generated for each cell which is equal to the total area of farms within that cell divided by the total area of farms sampled within that cell:

For each cell $Rf1_{sr}$ = (total area of farms within size group s in region r)/
(total area of farms visited within size group s in region r)

Any slight over- or under-sampling of a particular crop within a region may be corrected for, using a correction factor derived from the total area of that crop grown within the region divided by the grossed up estimate of the crop grown in that region:

For crop c $\quad Rf2_{cr}$ = (total area of crop c grown in region r)/
(Σ_{1n}(area of crop c grown on farm n in size groups in region r * $RF1_{sr}$))

RF2 should approximate to 1.

1.13 Defining the survey period

While a standard 12-month period from January through to December is the most logical period to survey, any crops other than perennial crops may well be grown in rotation. A particular field to be surveyed could have had two different crops growing on it within a single calendar year. The survey period should therefore cover 12 months and consider all pesticide applications made to the land on which the crop is grown over a 12-month period, defined by the cultural practices of the crop grown. For example, arable crops grown in Northern Europe are best surveyed over a period following the harvest of the previous season’s crop, to include any pre-drilling clean-up treatments to the land, then through drilling of the surveyed crop to harvesting in the survey year. Note that the survey year is always considered to be the year in which the harvest was taken. This is illustrated in Tables 1.6 and 1.7.

A decision has to be made on whether to include all pre-drilling treatments to the land in order to control weeds prior to sowing, or whether to include these as post-harvest treatments at the other end of the growing year. However, care must be taken not to omit both or include both, as the former would underestimate use while the latter would lead to double counting and overestimation.

Table 1.6 Schematic representation of survey period for autumn-drilled crops

July	**August**	**September**	**Oct-Dec**	**January-June**	**July**	**August**
	←		Survey period		→	
Harvest of previous crop	Pre-drilling clean-up	Drilling of survey crop	Autumn pesticide use	Spring pesticide use	Harvest of survey crop	Pre-drilling clean-up
				←	Survey year	→

For spring-sown crops, where land may have lain fallow since the previous harvest, any weed or pest control treatments to the land over that period should be associated with the crop that is grown subsequently. While they may not necessarily be appropriate applications to that crop, their omission will lead to an underestimate of national pesticide usage.

Table 1.7 Schematic representation of survey period for spring-drilled crops

July	August-December	January-June	July	August
	←	Survey period	→	
Harvest of previous crop	Autumn weed control ? Land lies fallow	Pre-drilling clean-up Drilling of survey crop Pesticide use	Pre-harvest pesticide use Harvest of survey crop	Pre-drilling clean-up
		← Survey year	→	

For short-term crops, such as lettuce, or any crops where more than one cycle is grown within a 12-month period, the optimum period during which data are recorded may well be influenced by the appropriateness or seasonality of other crops within the same survey. Lettuces grown under glass are therefore surveyed in Great Britain during the period October to September, as this is the period appropriate to the growth of many other protected crops. Because crops may grow more slowly during the winter than during the summer, it is important to record details of inputs during the whole 12-month period, rather than using the inputs for one crop and multiplying them up by the number of crops per year. Crops may require more protection from disease or pests during periods of slow growth and therefore have higher inputs at some times of the year than at others. Conversely, pest pressure may be higher during warm weather, resulting in inputs to some crops that are higher during the summer than in the winter.

Mushrooms may be considered over a 12-month period from January to December, as there is no true seasonality to the crop. Pesticide applications may vary within the year because of the influences of external temperatures, which may, for example, increase problems from sciarids or phorids in the summer months. Again, it is therefore important to record details of inputs during the whole 12-month period.

Perennial crops with a natural growing season, such as fruit crops, are best considered over a period commencing after the end of harvest in a given year through to the end of harvest in the following year.

However, it is important to remember to take the whole 12-month period into consideration, and any applications during the dormant period - such as winter washes, pruning paints or weed control - should not be excluded.

1.14 Training the staff

The pilot surveys carried out according to these guidelines clearly showed the benefit of close cooperation between the Statistical Offices and Plant Protection Services. The role of the Statistical Offices in establishing the sampling design, programming the surveys and processing the data is evident. The main inputs from the Plant Protection Services concern the provision of a complete and updated list of plant protection products related to the crop to be covered, with their composition in active substances. In addition, it is very important that the Plant Protection Services provide all relevant information on the crop to be covered in order to facilitate the task of the surveyors and the interpretation of the final results.

Depending on the particular conditions in the different countries involved in the pilot surveys, the direct involvement of surveyors from the Plant Protection Services has not always been found to be essential. In some cases it was even considered that direct participation of controllers for the Plant Protection Services in the interviews might give rise to conflicts of interest and confidentiality issues.

However, in any event, the training of the staff involved in the collection of data, and to some extent in the processing of data, has proved to be crucial to the success of the surveys and the quality of the data collected.

A farming background is useful, since it facilitates communication with and understanding of farmers. In the UK surveys, interviewers must have at least a degree in agriculture/horticulture and preferably a further degree in crop protection or previous experience working in crop protection or with pesticides. Transfer of know-how is ensured through the training of new recruits by experienced surveyors.

During the interviews, it is also important that the surveyors can rely on sound documentation about the crop covered and the specific pesticide treatments it can receive. For this reason, each survey should have:

- Its own standard forms;
- Full agronomic notes on each crop;
- Full instructions to surveyors covering (all) eventualities;
- New or unusual practices circulated among surveyors as the work progresses.

1.15 Carrying out the surveys

Visit surveys are usually undertaken retrospectively. Data are collected on all inputs to the crop up to the harvest and for a period covering the previous 12 months. In theory, visits could begin in autumn, but for practical reasons it is often better to wait for a quieter time of year.

Considering the complexity of the surveys, it can be relevant to cover different crops during the same interview, but this has to be already planned into in the sampling design. Care should be taken not to overburden farmers with long and complex questionnaires. A maximum of information should be collected during the interview so as to avoid having to go back to the farmer for additional information or to check the data provided. Using appropriate standard forms greatly facilitates this task.

Overburdening farmers with repetitive surveys can be a particular problem for big farms, which usually represent a small stratum in the sample and are covered exhaustively by several surveys. To avoid this problem, several countries have experimented with alternatives to survey visits for the big farms. Postal or e-mail surveys have proved to be efficient, especially if the relevant information is easily accessible for the farmer.

Postal or e-mail surveys are usually more flexible and can be undertaken during the crop year. Data on all inputs to the crop up to the harvest can be collected in one go or at regular intervals (monthly) through the life of the crop.

As already explained, the information on pesticide use should ideally be collected at the level of each field (observation unit) of the farm (sampling unit) for the crop(s) under consideration. However, some countries have experimented with grouping all the fields of a farm or the fields that have received the same treatments into 'observation clusters' or 'plots'. Another approach is to cover only the largest field of the farm. Such simplifications can reduce the length of the interviews, but in every case they will result in a loss of information (especially on the area treated) and their impact on the quality of the final results needs to be properly assessed. For instance, it has been demonstrated that for very common treatments with herbicides such simplification have very little impact on the results, but will have a significant effect on the accuracy of the results for treatments with insecticides, which are usually applied very locally.

In all cases, for both visits and postal surveys, the keeping of treatment records by farmers can greatly facilitate the interviews and improve the quality of the responses. Farmers that are to be surveyed can be issued with booklets prior to the survey season; alternatively, agrochemical companies sometimes give away free booklets to growers, which can be used during the interviews.
Some countries have also developed farm management software packages.

'Field-by-field' method versus 'farm' method

The choice of one or other method will depend on several considerations, which can arise at different stages in the organisation of the survey. Economic and practical considerations (cost of the survey, human resource availability, length of the interviews) can determine the choice of the approach when designing the survey. The availability of data at field level and the ability of farmers to separate the treatments between fields can also push the survey in the direction of a 'farm' approach. In practice, a balance has to be struck between the need to achieve highly detailed final results and the practical feasibility of the survey.

In general, for practical reasons, the field should be considered as the smallest observation unit. When treatments are applied locally on one field, the basic area treated should be considered as the area of the field.

A farm survey and a field-by-field survey answer different questions:

Farm survey: "This is what we do to wheat"
Field-by-field survey: "This is what we did to each field of wheat"

Where the aim is to collect data at active substance level, **the "field-by-field" method** will always be the most accurate. However, it is important to ensure that the whole exercise of processing individual data will allow the distinction between different fields to be maintained (there is no intermediate aggregation between fields and farms).
The "farm" method can be a good practical compromise when treatments are fairly homogeneous on all fields of a particular crop within the farms. However, this method will always involve information losses, since treatments applied on one field are spread onto the basic area treated of the whole farm.

Similarly, when successive crops (of the same or different varieties) occur on the same field, as is usually the case for vegetable production, it is advisable to cover the whole production period (over one year) and to assign a separate code to each successive crop.

1.16 Data storage and processing

Our intention is not to describe a single model for the storage and processing of survey data, as this aspect will depend very much on national traditions and preferences.

Within the different pilot projects, some countries collected the data on paper forms and began the actual data storage and processing at a later stage. In some cases, these two phases were completely separate and under the responsibility of different departments (Plant Protection Services and Statistical Offices).

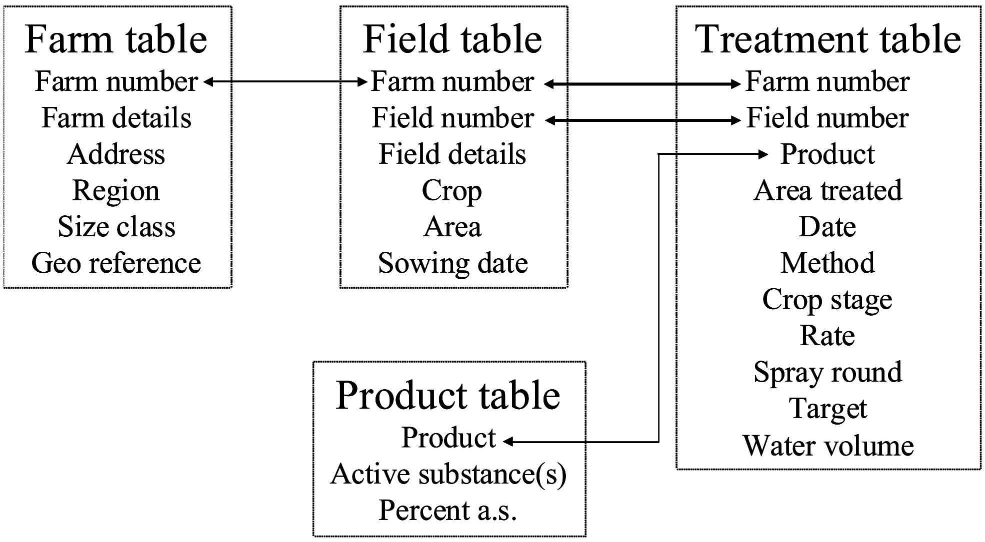
Some countries experimented with programmes that combined data storage and initial data checks, based on the identification of authorised plant protection products and standard application rates. These programmes were tested on laptops by interviewers directly during the visit or in postal interviews, or after these interviews.

Such programmes are based on relational databases and their purpose is to optimise the entry, storage, manipulation and analysis of data.

The following characteristics are common to programmes of this kind:

- They contain a pesticide database (list of approved products for different crops);
- Data are collected at product level from the grower;
- The product name is related to its active substance(s) in a database;
- The amount of product is converted into amount of active substance(s);
- Analysis is carried out at active substance level;
- The programmes may be used for sophisticated error checking;
- They may also include a database on approved uses, application rates, harvest intervals, etc.

Figure 1. 1 Typical structure of a programme for the collection of pesticide usage data



1.17 *Production of results*

As explained above, the results of pesticide usage surveys can be used at national level for different purposes. Some presentations of the results will require only the data collected in the survey to be aggregated at different levels (categories of products, types of farms, regions, etc.). More complex presentations, such as risk indicators, will require the combination of individual data on pesticide usage with external databases containing specific product properties, agronomic or agro-climatic data, parameters on crop development, etc.

It is therefore important that programmes used to store data allow the data to be aggregated at different levels and to be combined with external databases.

When reporting to the Commission, it is important to observe certain basic reporting requirements and adhere to certain standard definitions and classifications.

In the framework of the pilot projects on pesticide usage surveys, a standard transmission table has been prepared containing the essential parameters to be reported to Eurostat. National estimated values for each individual active substance had to be provided for each of the parameters set out below. These pilot surveys demonstrated the importance of defining basic aggregation rules to produce the national estimates for the different parameters (especially in order to aggregate results from different observation units and sampling units).

- **Quantity of active substance used (g, kg, t)**

This is the easiest definition to understand. However, the questionnaires do not ask for this information directly. It is derived from the information collected on commercial products combined with the table showing the content in active substance(s) of the different products. Depending on the kind of product (liquid or solid), concentrations in active substance(s) may be expressed in g/l, g/kg or %, but in all cases the final results have to be expressed in grams of active substance(s) used (or kg or tonnes). If different products containing one specific active substance are applied on one field (observation unit), then the quantity applied on this field is simply the sum of the quantities contained in the different products. There is thus no aggregation problem when the volumes of all products have been converted into active substances, since the total quantity of each active substance is simply the sum of all individual applications.

- **Total area surveyed/cultivated (ha)**

The total area surveyed is the sum of the areas cultivated with the crop in question for all the farms or fields covered by the survey. When the data are grossed-up at national (regional) level, the total area surveyed should correspond to the area cultivated with this crop at country (regional) level. The total area surveyed is that which is represented by the survey. It is usually given in advance in the sample frame. However, approaches may differ from country to country (survey of the whole farm area, a single field, etc). In the final reporting table, it is important that the treatments observed are associated with the correct area surveyed. It is important that, when a surveyor goes to a farm with a total area of wheat of 100 ha, but only asks questions about 10 ha, the report should clearly state that the quantities of products reported have been applied on 10 ha, so that the results can be multiplied up to obtain the area corresponding to the farm (which is the sampling unit).

- **Area treated (ha)**

The concept of area treated is the most difficult to embrace, since it can cover different situations on the ground.

Basic area treated

This is the physical area of the crop treated at least once with a given active substance, product or group of substances (e.g. fungicides, herbicides, etc.), independently of the number of applications. The basic area treated can be related to active substances or commercial products and considered either individually or for all products or active substances (in one specific group or in total). Practically, the concept of basic area treated is the most easily understood (and calculated), as it is the difference between the area cultivated and the area not receiving that particular substance(s) or product(s). Therefore, it will always be smaller than the area surveyed or cultivated. It should be noted that, when only one field per farm is covered by the survey, the total area surveyed will usually be identical or very close to the basic area treated (as the field covered receives the majority of the reported treatments).

For the purposes of reporting to Eurostat, the basic area treated should be considered exclusively in terms of individual active substances.

When several fields (observation units) receiving different treatments are covered in one farm (sampling unit), the basic area treated will normally differ from one active substance to another. The basic area treated has to be calculated for each active substance from the results of the different fields. For example, if 100 ha of a farm consist of 10 fields of 10 ha, of which five have been treated one or more times with products containing a given active substance, then the basic area treated with this active substance is 50 ha. If these same five fields plus two others are treated with products containing a second active substance, then the basic area treated with this second active substance is 70 ha.

It is important to note that the basic areas treated with different active substances cannot be grossed up to calculate the basic area treated with a given group or category of substances, since this would lead to double counting due to overlapping areas. It is also very important to realise that the basic area treated on a farm can only be calculated if each treatment is attributed to a single field and if the information on the different fields (observation units) is kept until the data are processed. Any simplifications in the collection of data in the farms (one farm = one field) will result in the basic area treated being closer to the area surveyed.

In addition to the concept of the basic area treated, which gives an indication of the physical dimension on which each single active substance has been applied, it may be useful to measure the 'gross' or 'developed' area treated that integrates the number of applications of a single substance on the basic area treated. Whereas the main value of the concept of ‘basic area treated’ is to measure the maximum pressure of a substance on a given area, the concept of 'gross area treated' is of particular interest when the risk associated with a given substance is dependent on the number of applications (e.g. residues in food). Different concepts can be used to reflect the gross area treated, but only the concept of "active substance area treated" is of interest when reporting to Eurostat.

Active substance area treated includes all multiple applications of a given active substance. It is calculated as the number of treatments with this specific substance times the basic area treated. A very simple example would be that five fields of the farm mentioned above have been treated twice with products containing the active substance in question. The active substance area treated with that substance will therefore be twice 50 ha, i.e. 100ha.

The original guidelines also described the concept of application area treated, which is the product of the basic area treated multiplied by the number of different applications it receives, irrespective of the number of products in the application (tank-mix) and the concept of formulation area treated, which is the product of the basic area treated multiplied by the number of products (formulations) it receives.

These definitions can be of interest, especially when results are examined from an agronomical point of view, for instance in order to compare the number of treatments involving fungicides applied to wheat in different regions. Since Eurostat’s main objective is to calculate risk indicators, the level of active substances is the only relevant indicator and only the results on the basic area treated and on the active substance area treated should be considered. This choice is reflected in the standard reporting format, which presents all information at the level of individual active substances.

- **Intensity of treatment**

The intensity of treatment (kg/ha) is reflected by the quantity of active substance applied, divided by either the basic area treated or the total cultivated area. It is the result of calculations based on the observations in the questionnaires.

Average quantity applied per treated area: the total quantity of active substance applied divided by the basic area treated (kg/ha).

Average quantity applied per total (surveyed) cultivated area: total quantity of active substances applied divided by the area (surveyed) cultivated (kg/ha).

Average number of applications: for each active substance this is calculated as the ratio between the active substance area treated and the basic area treated. The average number of treatments can also be obtained directly from the individual observations collected in the survey.

It should be noted that it is not possible to calculate the average number of applications for groups or categories of substances from the average number of applications for each substance. In that case, the basic area treated and the grossed-up area treated have to be calculated at the level of the group or category of substances.

How to produce results from field observation tables?

FIRST EXAMPLE

First, let us take the simple example of a farm growing 3 ha of wheat on two fields of 1 ha and 2 ha respectively. The example shows how to calculate the basic reporting parameters from the observation tables 8, 9, and 10.

Table 1.8 Field Table F1

Area of the field: 1 ha

date	treatment	Qt (kg or l)	AS (g/kg or l)	Area treated (ha)	Qt AS (g)
d/m/y	T1	1 kg	X (30)	1	30
			Y (20)	1	20
			Z (10)	1	10
d/m/y	T3	2 kg	X (30)	1	60
			W (30)	1	60
d/m/y	T5	1 l	X (60)	1	60
…					

Table 1.9 Field Table F2

Area of the field: 2 ha

date	treatment	Qt (kg or l)	AS (g/kg or l)	Area treated (ha)	Qt AS (g)
d/m/y	T2	2 kg	X (30)	2	60
			Y (20)	2	40
d/m/y	T4	2 kg	V (40)	2	80
			W (40)	2	80
d/m/y	T5	1 l	X (60)	2	120
…					

Table 1.10 Farm table

Total area cultivated with wheat: field F1 + Field F2 = 3 ha

AS	**Qt AS (kg)**	**Basic area treated (ha)**	**Average N° applications**	**Average quantity applied per treated area (g/ha)**	**Average quantity applied per total cultivated area (g/ha)**
V	80	2	2/2=1	40	27
W	140	3	3/3=1	47	47
X	330	3	7/3=2.3	110	110
Y	60	3	3/3=1	20	20
Z	10	1	1/1=1	10	3
…					

Calculation of the basic areas treated

Basic area treated with active substance V: 2 ha on F2 = 2 ha
Basic area treated with active substance W: 1 ha on F1 + 2 ha on F2 = 3 ha
Basic area treated with active substance X: 1 ha on F1 + 2 ha on F2 = 3 ha
Basic area treated with active substance Y: 1 ha on F1 + 2 ha on F2 = 3 ha
Basic area treated with active substance Z: 1 ha on F1 = 1 ha

Calculation of the active substance area treated
Active substance area treated with V: 2 ha on F2 = 2 ha
Active substance area treated with W: 1 ha on F1 + 2 ha on F2 = 3 ha
Active substance area treated with X: 3x(1 ha on F1) + 2x(2 ha on F2)= 7 ha
Active substance area treated with Y: 1 ha on F1 + 2 ha on F2 = 3 ha
Active substance area treated with Z: 1 ha on F1 = 1 ha

Calculation of the average number of applications:
First step: calculate the **Active substance area treated** which is the sum of the area treated with the different products containing the relevant active substance (gross area treated).
Second step: divide this sum by the **basic area treated** with this active substance.
Example for X, which is applied on field F1 in treatments T1, T3, T5
And on parcel YYY in treatments T2 and T5:
Average number of applications for X: (1ha+1ha+1ha+2ha+2ha)/3ha or (3x1ha) + (2x2ha)/3ha = 2.3

SECOND EXAMPLE

This second example is based on realistic field observation tables, and it illustrates the different steps necessary to produce harmonised results that are compatible with Eurostat's standard reporting format.

Step 1: Compile field sheets

In this example, field data compilation tables are based on the model of a booklet used by a French farmers' association to keep records on pesticide and fertiliser applications. In that case, data are very easy to retrieve since each field is covered by one sheet.

Table 1.11 Models of field tables

Name of the producer	EXAMPLE	Crop	WHEAT
Production year	2006	Variety specify if GMO	Charger
Field Name	Hill	Seed treatment	Kinto TS 0.15 l/q
IACS N°	11	Sowing date	28/09/2005
			300
			)/07/2006
			Beet

Name of the producer	EXAMPLE	Crop	WHEAT
Production year	2006	Variety specify if GMO	Caphorn
			elest 0.2 l/q
			5/09/2005
			300
			5/07/2006
			Beet

Name of the producer	EXAMPLE	Crop	WHEAT
Production year	2006	Variety specify if GMO	Apache
Field Name	Village	Seed treatment	Celest 0.2 l/q
IACS N°	7	Sowing date	25/09/2005
Total Field Area (ha)	12 ha 20	sowing density	300
Area that can be treated (ha) (without edges, buffer zones, etc)	12 ha 20	Harvest date	26/07/2006
		Previous crop	Beet

Plant protection treatments				
Date	Product	area treated (ha)	Dose/ha	Observations
10-Oct-05	Decis expert	8 ha	0.075 l/ha	
20-Oct-05	Matara	12 ha 20	2.4 l/ha	
20-Oct-05	First	12 ha 20	0.75 l/ha	
29-Mar-06	Starane	4 ha	0.4 l/ha	
30-Mar-06	Bell	12 ha 20	1.5 l/ha	
15-Apr-06	Opus	4 ha	1 l/ha	

Step 2: Group together all the fields in a farm

Since the farm is usually the sampling unit, data on the different fields should be gathered for the whole farm. The farm table presented below groups all the information about the farm, but still enables the different treatments on the different fields to be identified.

Table 1.12 Model of farm table

Name of the producer		EXAMPLE	Field Name	Big Field	Village	Hill		
Production year		2006	Variety specify if GMO	Caphorn	Apache	Charger		
CROP		WHEAT	IACS N°	4	7	11		
Summary table			Seed treatment	Celest 0.2 l/q	Celest 0.2 l/q	Kinto TS 0.15 l/q		
			Total Field Area (ha)	5 ha 40	12 ha 20	6 ha 50		
			Area that can be treated (ha) (without edges, buffer zones, etc)	5 ha 35	12 ha 20	6 ha 50		
			Previous crop	Beet	Beet	Beet		
Plant protection treatments								
Date	Product	Dose/ha	Observations	area treated (ha)	area treated (ha)	area treated (ha)		
10-Oct-05	Decis expert	0.075 l/ha		5 ha 35	8 ha	-		
20-Oct-05	Matara	2.4 l/ha		5 ha 35	12 ha 20	6 ha 50		
20-Oct-05	First	0.75 l/ha		5 ha 35	12 ha 20	6 ha 50		
21-Mar-06	Atlantis WG	0.25 kg/ha		5 ha 35	-	6 ha 50		
21-Mar-06	Vegelux	0.8 l/ha		5 ha 35	-	6ha 50		
29-Mar-06	Starane	0.4 l/ha		5 ha 35	4 ha	2 ha 50		
30-Mar-06	Bell	1.5 l/ha		5 ha 35	12 ha 20	6 ha 50		
15-Apr-06	Opus	1 l/ha		5 ha 35	4 ha	6 ha 50		
			Date of harvest	25/07/2006	26/07/2006	30/07/2006		

Step 3: Convert doses into quantities of products

Doses of products are multiplied by the area treated to obtain the quantity (in litres or kg) of product applied in each treatment.

Table 1.13 Conversion table doses-quantities

Date	Product	dose/ha	Field 1 5.35 ha		Field 2 12.20 ha		Field 3 6.5 ha	
			Area treated (ha)	Quantity (kg or l)	Area treated (ha)	Quantity (kg or l)	Area treated (ha)	Quantity (kg or l)
seed	Celest	0.3 l/ha	5.35	1.6 l	12.2	3.7 l	-	-
seed	Kinto TS	0.225 l/ha	-	-	-	-	6.5	1.5 l
10-Oct-05	Decis expert	0.075 l/ha	5.35	0.4 l	8	0.6 l	-	-
20-Oct-05	Matara	2.4 l/ha	5.35	12.84 l	12.2	29.28 l	6.5	15.6 l
20-Oct-05	First	0.75 l/ha	5.35	4.01 l	12.2	9.15 l	6.5	4.88 l
21-Mar-06	Atlantis WG	0.25 kg/ha	5.35	1.34 kg	-	-	6.5	1.63 kg
21-Mar-06	Vegelux	0.8 l/ha	5.35	4.28 l	-	-	6.5	5.2 l
29-Mar-06	Starane	0.4 l/ha	5.35	2.14 l	4	1.6 l	2.5	1 l
30-Mar-06	Bell	1.5 l/ha	5.35	8 l	12.2	97.9 l	6.5	9.75 l
15-Apr-06	Opus	1 l/ha	5.35	5.35 l	4	4 l	6.5	6.5 l

Step 4: Convert products into active substances

Converting the quantity of products into their active substance component requires a product database that contains the composition of all products authorised for use on wheat. Since products are authorised at national level and can have different names and compositions from one country to another, these databases should be compiled at national level.

Table 1.14 Product-active substance conversion table

Product	*Active substances*	*Qt*	
Décis expert	Deltamethrin	100	g/l
Matara	Isoproturon	500	g/l
First	Bromoxynil	125	g/l
	Diflufenanil	40	g/l
	Ioxynil	75	g/l
Atlantis WG	Metsulfuron-methyl	3	%
	Iodosulfuron	0.6	%
	Mefenpyr	9	%
Vegelux	Paraffinic oil	946	g/l
Starane	Fluroxypyr	200	g/l
Bell	Boscalid	233	g/l
	Epoxiconazole	100	g/l
Opus	Epoxiconazole	125	g/l
Seed treatment			
Celest	Anthraquinone	250	g/l
	Fludioxonil	25	g/l
Kinto TS	Anthraquinone	333	g/l
	Prochloraz	100	g/l
	Triticonazole	23.3	g/l

Step 5: Calculate quantities of active substances and area treated at farm level

Table 1.15 Active substance calculation table

Treatment N°	Product	Active substances	Field 1 Area (ha)	Field 1 Quantity grams	Field 2 Area (ha)	Field 2 Quantity grams	Field 3 Area (ha)	Field 3 Quantity grams	Total Qt a.s. applied (grams)	Total area treated
1	Celest	Anthraquinone	5.35	400	12.2	925	-	-	1325	17.55
		Fludioxonil	5.35	40	12.2	92.5	-	-	132.5	17.55
2	Kinto TS	Anthraquinone	-	-	-	-	6.5	500	500	6.5
		Prochloraz	-	-	-	-	6.5	150	150	6.5
		Triticonazole	-	-	-	-	6.5	35	35	6.5
3	Decis expert	Deltamethrin	5.35	40	8	60	6.5	0	100	13.35
4	Matara	Isoproturon	5.35	6420	12.2	14640	6.5	7800	28860	24.05
5	First	Bromoxynil	5.35	501	12.2	1144	6.5	610	2255	24.05
5	First	Diflufenanil	5.35	160	12.2	366	6.5	195	721	24.05
5	First	Ioxynil	5.35	300	12.2	686	6.5	366	1352	24.05
6	Atlantis WG	Metsulfuron-methyl	5.35	40	-	-	6.5	49	89	11.85
6	Atlantis WG	Iodosulfuron	5.35	8	-	-	6.5	10	18	11.85
6	Atlantis WG	Mefenpyr	5.35	121	-	-	6.5	147	268	11.85
7	Vegelux	Paraffinic oil	5.35	4048	-	-	6.5	4919	8967	11.85
8	Starane	Fluroxypyr	5.35	428	4	320	2.5	200	948	11.85
9	Bell	Boscalid	5.35	1872	12.2	4270	6.5	2275	8417	24.05
9	Bell	Epoxiconazole	5.35	535	12.2	1220	6.5	650	2405	24.05
10	Opus	Epoxiconazole	5.35	669	4	500	6.5	812	1981	24.05
		Total 10 treatments							58523.5	24.05

Step 6: Group data at active substance level

The following table presents a typical calculation sheet allowing the main indicators to be calculated, based on quantities of active substance applied and areas treated. Such a table can be used at farm level or with data grossed up at national, regional or any other aggregation level. In this case, farm data from the previous example are presented.

Table 1.16 Active substance calculation sheet

= sum across all applications of (area treated x grower's rate of application)

Area surveyed (in ha) = 24.1

Note: as the data are unraised, comparison is made against the area surveyed, not the national census area

Active substance	Active substance area treated (ha)	Weight of a.s. applied	Proportion of total pesticide active substance area treated	Proportion of census area treated	Average number of applications	Basic area treated (ha)
Anthraquinone	24.05	1825	0.08	1.00	1.0	24.05
Fludioxonil	17.55	132.5	0.06	0.73	1.0	17.55
Prochloraz	6.5	150	0.02	0.27	1.0	6.5
Triticonazole	6.5	35	0.02	0.27	1.0	6.5
Deltamethrin	13.35	100	0.05	0.55	1.0	13.35
Isoproturon	24.05	28860	0.08	1.00	1.0	24.05
Bromoxynil	24.05	2255	0.08	1.00	1.0	24.05
Diflufenican	24.05	721	0.08	1.00	1.0	24.05
Ioxynil	24.05	1352	0.08	1.00	1.0	24.05
Metsulfuron-methyl	11.85	89	0.04	0.49	1.0	11.85
Iodiosulfuron	11.85	18	0.04	0.49	1.0	11.85
Mefenpyr	11.85	268	0.04	0.49	1.0	11.85
Paraffinic oil	11.85	8967	0.04	0.49	1.0	11.85
Fluroxypyr	11.85	948	0.04	0.49	1.0	11.85
Boscalid	24.05	8417	0.08	1.00	1.0	24.05
Epoxiconazole	48.1	4386	0.16	1.00	2.0	24.05
Total	295.55	58523.5	1.00	1.00	12.3	24.05

= sum of areas treated with different a.s.	= sum of weights applied for different a.s.	= Bn/B26	= basic area treated/B3 = Gn/B3	= B10/basic area treated =Bn/Gn

this is the sum of areas treated with epoxiconazole + sum of areas treated with epoxiconazole/boscalid

Step 7: Gross up data at national level and complete the reporting sheet.

The next table presents a simple example of the standard reporting format that was used to report to Eurostat on the results of pilot surveys on pesticide use in 2007. In this example, although the data have not been grossed up at national level, they relate to the same farm example as that shown above.

Table 1.17 Active substance standard reporting format

MAJOR GROUPS & *Categories of products*	Chemical Class	Active substances (BCPC)	WHEAT					
		Common Nomenclature	Total Area Surveyed (ha)	Basic area treated (ha)	Average N° applications (facultative)	quantity a.s. applied (g)	Average quantity applied per treated area (g/ha)	Average quantity applied per total cultivated area (g/ha)
Fungicides			**24.10**	**24.05**	**2.70**	**13120.50**	**545.55**	**544.42**
imidazoles and	CONAZOLE FUNGICIDES	TRITICONAZOLE		6.50	1.00	35.00	5.38	
imidazoles and	CONAZOLE FUNGICIDES	EPOXICONAZOLE		24.05	2.00	4386	182.37	
Other fungicides	AMIDE FUNGICIDES	PROCHLORAZ		6.50	1.00	150.00	23.08	
Other fungicides	PHENYLPYRROLE	FLUDIOXONIL		17.55	1.00	132.50	7.55	
Other fungicides	AMIDE FUNGICIDES	BOSCALID		24.05	1.00	8417.00	349.98	
Herbicides				**24.05**	**3.00**	**34511.00**	**1434.97**	**1431.99**
amides and anilides	ANILIDE HERBICIDES	DIFLUFENICAN		24.05	1.00	721.00	29.98	
urea, uracil or of	SULFONYLUREA	IODOSULFURON		11.85	1.00	18.00	1.52	
urea, uracil or of	SULFONYLUREA	METSULFURON		11.85	1.00	89.00	7.51	
urea, uracil or of	UREA HERBICIDES	ISOPROTURON		24.05	1.00	28860.00	1200.00	
Other herbicides	NITRILE HERBICIDES	BROMOXYNIL		24.05	1.00	2255.00	93.76	
Other herbicides	NITRILE HERBICIDES	IOXYNIL		24.05	1.00	1352.00	56.22	
Other herbicides	PYRIDYLOXYACETIC-ACID	FLUROXYPYR		11.85	1.00	948.00	80.00	
Other herbicides	OTHER HERBICIDES	MEFENPYR		11.85	1.00	268.00	22.62	
Insecticides				**24.05**	**0.60**	**100.00**	**4.16**	**4.15**
pyrethroids	PYRETHROID	DELTAMETHRIN		13.35	1.00	100.00	7.49	
Other PPP				**24.05**	**1.50**	**10792.00**	**448.73**	**447.80**
Mineral oils	MINERAL OIL	PETROLEUM OILS		11.85	1.00	8967.00	756.71	
All other plant	OTHER PPP	ANTHRAQUINONE		24.50	1.00	1825.00	74.49	
Total Plant Protection						**58523.50**	**-**	**2428.36**

2. A case study: Pesticide use in the new Member States and candidate countries

Between March 2007 and March 2008, 13 new Member States and candidate countries to the EU conducted pilot surveys on the use of pesticides under the multi-beneficiary and transition facility statistical cooperation programmes for 2005. For most of them this experience was a follow-up to a similar initiative in 2005 and led to the collecting of representative national data on the use of pesticides on wheat. This section presents the main results and methodology improvements resulting from this example of fruitful international co-operation.

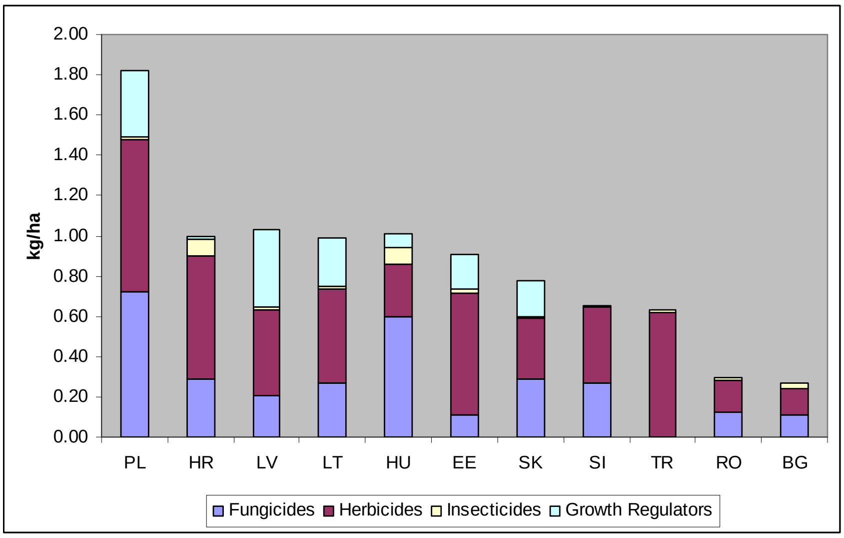


Figure 2.1 Average dose of application of plant protection products (kg of active substance per hectare of wheat cultivated)

2.1. Key findings

Beyond the detailed analysis of the results of the national surveys, this pilot project demonstrated the interest of a harmonised methodology. First of all, it facilitated the exchange of experience between the participating countries, but it also allowed easier comparison of the national results by calculating similar indicators. So far, only indicators of the intensity of use of plant protection products at the national level have been calculated, but the ultimate aim of pesticide use surveys is to monitor the trends of the risk to human health and the environment that are associated with pesticides.

This section presents the main results obtained on wheat, as this crop was covered by most participating countries and therefore provides the most comparable data at this stage. The most obvious indicator of the intensity of use is the quantity of active substance applied by hectare of cultivated area. Figure 2.1 shows a comparison of the average dose per hectare for the different categories of plant protection products used in wheat production. Although the indicator is independent of the size of the area cultivated, it should be noted that the results are representative of the whole country in most cases, but limited to the region of the survey in the case of Croatia, Turkey and to some extent Poland (limited to three provinces. Moreover, no results are presented for Cyprus and Malta, since wheat is not a significant crop in Malta and in Cyprus the wheat cultivation is important especially in the arid areas but the production of the island is not significant in the European wheat production. The results show some similarities between countries within the same region (the Baltic countries, Slovenia and Slovak Republic, etc) albeit with major variations between the different countries. These variations reflect different strategies for the protection of wheat which are partly determined by the production objectives and climate, but which can also be explained in part by the main active substances used, which are applied at significantly different rates.

2.2. A common approach to data collection

The surveys carried out under the 2005 co-operation programme were, for most of the participating countries, a continuation of pilot projects initiated in 2005; they focused on the collection of meaningful data on the use of plant protection products that enabled further estimates to be made of the risk to the environment and human health.

The first pilot project in 2005 focused on staff training, setting up institutional cooperation and familiarisation with the methodology for data collection through small-scale surveys on a selection of crops. Eleven of the 12 new Member States took part in this first project, the exception being Cyprus. In 2007, all 12 new Member States except the Czech Republic participated in the project, and they were joined by Turkey and Croatia. The aim of this second initiative was to consolidate the institutional network and construct a sustainable national survey system that would meet the requirements of the future Regulation.

Nine of the already experienced Member States conducted a national survey on the use of plant protection products on wheat. Malta, which had already carried out a full national survey in 2005, reproduced a similar survey paying particular attention to the methodological aspects. Cyprus, Turkey and Croatia, for whom this was the first experience in this field, were asked to set up the administrative structure and to experiment with the methodology by organising small-scale pilot surveys on a small selection of crops, including wheat. The success of this broad co-operation was ensured by the active participation of all beneficiary countries in regular workshops, and short-term country visits by experts from ASA-ICON Institutes.

This section describes and compares the results of the national surveys on wheat, focusing on the main aspects developed during the project:

- The definition of the sampling unit at farm or field level;
- The possibility of stratifying the samples according to farm size and/or technical orientation, and by region;
- The production of national estimates;
- The definition of the accuracy of the final results.

The three workshops organised in the course of this project provided an excellent opportunity to exchange experience and to develop different aspects of the methodology described in the initial "Guidelines for the collection of pesticide usage statistics within agriculture and horticulture". Specific definitions and concepts, such as sampling unit (usually the farm) versus observation unit (the farm or the field parcel), and area treated (sprayed once or several times with a specific pesticide) versus area surveyed, had to be refined. Progress in the project and in the different country surveys was reported regularly in a bi-monthly newsletter sent to those taking part in the project.

Given the technical complexity of the subject under investigation, close collaboration between statistical services and plant protection services was strongly recommended. An administrative cooperation network was therefore put in place and worked very well in almost all participating countries. The statistical services were generally involved in the design of the sampling approach and in the collection, processing and interpretation of the data. The role of the plant protection services was principally to identify the plant protection products to be covered by the survey, to check the reliability of the information provided by famers and to interpret the final results. In most cases, the preparation of the questionnaire was a joint venture between both services and, very often, surveyors either were from – or had been trained by – the plant protection administration.

The quality of the questionnaire was acknowledged as a key element in the success of the survey and the quality of the data. In some cases, the paper questionnaire was supplemented or replaced by an electronic form connected directly to product databases.

Regarding the sampling approach, as Table 2.1 shows, most countries opted for a simple random sampling approach (Neyman type) based on a sample frame derived usually from their national farm registers. The sample size varied significantly from country to country, ranging from 250 units to 4000 units (farms in all cases). This can of course be explained by the size of the countries, but also by the fact that a similar budget was allocated to each country to observe the impact of optimal allocation of the resources on the quality of the results.

Ideally, the observation unit should be as close as possible to the size of the plots on which the different plant protection treatments are applied. This approach allows a better estimation of the actual area treated with each single product or substance. However, as a compromise, which was necessitated by the limited resources allocated to this project, there was an almost equal split between field and farm as the chosen observation unit. It was possible to show that the impact of this choice on the quality of the final results depends very much on the variability of the treatments applied by the farmers to the different fields of a crop in their farm. Amongst the different types of treatments, insecticides – which are usually applied on limited areas – were most affected by the aggregation of different fields into a single observation unit and by the resulting loss of information.

In most cases, the countries opted for the face-to-face interview method, which is considered to be most effective, as it leads to high response rates and good quality responses. However, some countries demonstrated the interest of other methods, such as phone or e-mail interviews, which in some cases can even improve the quality of the results.

Almost all countries were able to calculate national estimates for the consumption of plant protection products in the crop covered, except those countries that were carrying out a small-size pilot survey for the first time. In most cases, it was also possible to calculate the accuracy of the national estimates.

Table 2.1 Description of the survey methodology for the different participating countries

	Sampling					Data collection		National estimates	Crop
	Frame	Method	Stratification	Total number of farms	Surveyed farms	Mode	Unit		
BG	IACS	Optimal precision	National level	14230	485	Face to face	Farm	Yes	Wheat
EE	FR	Simple random sampling	9 size classes	3793	1739	Postal, Phone	Farm	Yes	Wheat
CY	FR 03	Selection	No	:	250	Face to face	Parcel	No	5 crops
LV	FR 01, IACS	Optimal allocation	26 districts, 6 size classes	14279	904	Face to face	Farm	Yes	Wheat
LT	IACS	Optimal allocation	7 size classes	34533	483	Face to face	Parcel	Yes	Wheat
HU	FSS 05	1-stage stratified random	20 regions, 3 size classes	:	590	Face to face, e-mail	Farm	Yes	Wheat
MT	FR 01	optimal allocation, Random sampling	6 size classes	8617	400	Face to face	Parcel	Yes	15 crops
PL	FR 02	Optimal allocation, systematic random sampling	3 regions, 5 size classes	710176	510	Face to face	Parcel	Estimate	Wheat
RO	FR 03	Optimal allocation, systematic random sampling	National level	1036135	4000	Face to face	Parcel	Yes	Wheat
SI	FSS 07	Stratified simple random sampling	12 regions	21000	2900	Face to face, postal, phone	Parcel	Yes	Wheat
SK	FR 07, census area sown 07	Optimal allocation	3 regions, 6 size classes	3039	1000	Postal	Farm	Yes	Wheat
HR	FR 03	Selection	No	10708	260	Face to face, postal	Farm	No	Wheat
TR	FR	Stratified random sampling	No	:	260	Face to face	Farm	No	5 crops

2.3. Survey results

Most of the participating countries covered the use of plant protection products in the production of wheat for the harvest year 2006 or 2007. All countries for which it was the second experience of pesticide usage surveys were requested to cover a sample of farms that was large enough to allow an extrapolation of the results at national level. Most of the results presented in this paper can thus be regarded as being representative of the whole country for the production of wheat. Croatia and Turkey - for whom it was the first pilot survey - were not required to produce such estimates. Owing to the size of its territory and limited budget, Poland decided to restrict the survey to three provinces. The results presented for Poland concern the whole country, but should be treated with caution, since the three provinces are not fully representative of the whole country.

Beyond the broad distribution in the volumes of plant protection products used on wheat in the different countries, which is directly linked to the importance of the crop (Table 2.2), it is possible to observe variations in the intensity of use for the different categories of products and in the list of the main active substances used.

Intensity of use, expressed as the quantity of active substances used per hectare of wheat cultivated, ranges from 0.27 kg/ha in Bulgaria to 1.84 kg/ha in Poland (Figure 2.1, Table 2.3). Such variations can be explained by the different approaches adopted in respect of the protection of wheat in each country. These are largely influenced by climatic conditions, incidence of diseases, differences in economic objectives, and - to some extent - by the price and availability of plant protection products on national markets.

Table 2.2 Main results by country

	Crop	Year	Area	Number	quantity of active substances used (kg)				
			(ha)	of AS	All	Fungicides	Herbicides	Insecticides	Growth Regulators
BG	Wheat	2007	975153	55	260,082	106,194	127,238	26,650	0
EE	Wheat	2006	90842	72	83,025	9,982	54,956	1,614	16,043
CY	*Wheat**	*2006*	*351*	*9*	*1,929*	*0*	*1,721*	*208*	*0*
LV	Wheat	2006	223403	61	229,707	46,301	95,486	2,975	84,946
LT	Wheat	2006	307185	58	303,572	82,968	143,267	3,774	73,563
HU	Wheat	2006	933789	65	872,469	559,315	244,062	3,987	64,880
MT	*All crops*	*2007*	*8100*	*85*	*120,730*	*116,721*	*2,958*	*930*	
PL	Wheat	2006	1753401	116	3,220,925	1,270,443	1,323,038	24,011	570,153
RO	Wheat	2007	2017537	63	603,346	243,540	326,957	28,091	950
SI	Wheat	2007	32858	61	21,489	8,873	12,407	174	29
SK	Wheat	2006	326633	106	265,638	95,457	107,843	2,228	59,977
HR	*Wheat**	*2007*	*38146*	*41*	*43,722*	*11,040*	*23,402*	*2,997*	*518*
TR	*Wheat**	*2006*	*1499*	*14*	*946*	*0*	*929*	*17*	*0*

** The countries marked have carried out limited-scale surveys on five different crops, including wheat. The data presented for these countries concern wheat only.*

However, national averages give only a very general view and can cover different phenomena, such as a variation in the proportion of crops without pesticide treatment or regional variations in the intensity of treatment. Such detailed analysis would require regionally representative surveys for each individual plot, which were not carried out in all countries.

An initial finding, looking beyond the broad distribution of the average dose for all plant protection products, is the wide variation in the contribution of the different types of products. In general, the highest volumes of fungicides and insecticides are explained by higher pest and disease pressures and more intensive production patterns, and a necessity to maintain the highest potential yields.

Differences in the use of herbicides are partly explained by the importance of weed control in wheat in the different countries, but they were also clearly related to the preparation of the fields before sowing and to the replacement of frozen crops in specific cases.

The use of growth regulators is mainly related to climatic conditions and to the selection of wheat varieties that make it necessary to limit the growth of the crop.

Table 2.3: Average intensity of treatment (kg active substance/ha wheat cultivated)

	BG	EE	HR	HU	LT	LV	PL	RO	SI	SK	TR
Fungicides	0.11	0.11	0.29	0.60	0.27	0.21	0.72	0.12	0.27	0.29	0.00
Herbicides	0.13	0.60	0.61	0.26	0.47	0.43	0.75	0.16	0.38	0.30	0.62
Insecticides	0.03	0.02	0.08	0.08	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Growth Regulators	0.00	0.18	0.01	0.07	0.24	0.38	0.33	0.00	0.00	0.18	0.00
Total	**0.27**	**0.91**	**1.15**	**0.93**	**0.99**	**1.03**	**1.84**	**0.30**	**0.65**	**0.82**	**0.63**

2.4. Variations in the plant protection patterns

Active substances are the components of plant protection products that mainly determine both their biological activity and their potential environmental impact. All relevant analyses of pesticide use should be based on the individual active substances. Tables 2.4 and 2.5 show two different approaches to analyse the results of the pesticide use surveys at the level of the active substances. Table 2.4 presents the top-5 lists of active substances in each category of products according to the quantity used in each country. Table 2.5 looks at the main substances used according to the area of wheat treated. Both approaches are important as a way of analysing the different plant protection patterns, since the quantity of an active substance used depends on its frequency of use and on the dosage applied.

A comparison of the top-5 lists for the different categories of active substances reveals some similarities in the choice of products. A predominance of substances from the chemical classes of the 'conazoles', 'morpholines' and 'benzimidazoles' is observed for fungicides. The 'phenoxy', 'urea' and 'sulfonylurea' share top place on the list for herbicides. 'Pyrethroid' and 'organophosphorus' insecticides are the most commonly used, though usually sprayed on limited areas depending on the presence of pests. Growth regulation treatments - when they are used - are based on a very limited list of substances, with a general preference for 'chlormequat'. Beyond these common patterns, however, the overall picture is largely dominated by the range of different products, both in quantitative terms and as regards the proportion of crop treated; the Baltic countries are the notable exception, as they all exhibit very similar profiles.

Since no standard approach had been agreed to express the accuracy of the results, it is difficult to compare the quality of the different national estimates. The accuracy of the national estimates depends, of course, on both the size of the sample and on the correct estimation of the total area cultivated with the respective crop. The quality of the farm registers that usually constitute the sampling reference is therefore very important. Another aspect that influences the accuracy of the results as regards quantities of active substances used is their frequency of use; extrapolations are much more precise for the most widely used substances. Two countries have calculated the error on the extrapolated dosage of active substances per hectare. Poland estimated the relative standard error for the average pesticide dosage per province at between 4.3 and 6.3%. In Bulgaria, the maximum relative standard error on average dosages calculated, without considering the stratification of the sample, ranged from 18% for fungicides to 50% for insecticides, with an overall error of 15%. Estonia's calculations of the relative standard error on the quantity of each active substance showed that it varies considerably from one substance to another and can be as high as 40% for substances used in small quantities. Estonia estimated the percentage error at 0.3% for fungicides, 0.8% for herbicides, 1.1% for insecticides, 0.4 % for growth regulators, and 0.58% overall. Lithuania estimated the relative error on the quantities and areas treated with the main active substances used: the error for both quantities and areas is below 1%. In Slovenia, the relative error on the area treated with individual active substances varied from 2.6% to 99% depending on the number of plots treated. 80% of the estimated areas treated with herbicides had a relative error of less than 5%; 60% had a less than 8% error for fungicides, and almost all areas treated with insecticides had an error rate of under 13%. Similar values were found in respect of the quantities applied.

2.5. Main conclusions

It is of course difficult to draw major conclusions from a survey that is limited to a single crop in 13 countries. However, this project has demonstrated that, with a harmonised approach, it is possible to collect comparable data that enable a comparison of plant protection patterns between countries. Such surveys – if repeated over time and on different crops - would build up a broader picture of the overall use of plant protection products.

This study also indicates the limited usefulness of comparing very general indicators, such as the quantity of product used or the average quantity of active substance applied per hectare. Such comparisons are of limited value and can be misleading if details of active substances are not analysed. One method of comparing countries with slightly different plant protection patterns or of keeping track of changing patterns over time is to calculate risk indicators.

As indicated in the results of the HAIR project (HAIR, 2007), the calculation of pesticide risk indicators involves combining data on toxicity, which mainly depends on the intrinsic properties of individual active substances, with data on the exposure to these substances or their residues for humans or different parts of the environment. Detailed data on the use of pesticides constitute an essential input for the calculation of such indicators in combination with data sets on the properties of active substances and agro-climatic information.

Collecting meaningful data on the use of plant protection products so as to allow further estimation of the risk for the environment and human health was the main objective of these surveys. It can definitely be concluded from this project that such data can be collected with sufficient accuracy by means of sample surveys.

As a follow-up to this project, Eurostat - together with a consultant, ARCADIS Belgium - is currently testing the HAIR programme with a selection of data collected under this project. The results of these calculations will be the subject of a future publication.

While this project clearly highlighted the value of using a harmonised methodology to collect data, it also showed the need to better harmonise the quality criteria used to estimate the accuracy of the national estimates and to investigate further the impact of different stratification methods on the quality of the final results.

Table 2.4 Top-5 list of active substances used on wheat as a percentage of the total quantity of active substances used in each group.

	BG	%	EE	%	HR	%	HU	%	LT	%
Fungicides	CARBOXIN	31.70	TEBUCONAZOLE	30.07	PROPICONAZOLE	29.23	EPOXICONAZOLE	28.54	THIRAM	40.52
	THIRAM	31.61	FENPROPIMORPH	16.76	CARBENDAZIM	21.68	SULFUR	17.69	TEBUCONAZOLE	16.80
	TEBUCONAZOLE	5.65	EPOXICONAZOLE	12.19	EPOXICONAZOLE	19.34	FENPROPIMORPH	10.34	FENPROPIMORPH	7.53
	TRIBASIC COPPER SULPHATE	5.06	SPIROXAMINE	7.46	TEBUCONAZOLE	9.65	KRESOXIM-METHYL	7.12	PROPICONAZOLE	7.22
	SPIROXAMINE	4.39	PROPICONAZOLE	4.30	AZOXYSTROBIN	8.02	CARBENDAZIM	6.32	SPIROXAMINE	5.46
Herbicides	2,4-D	77.49	MCPA	50.61	CHLORTOLURON	79.88	MCPA	22.35	GLYPHOSATE	49.33
	ISOPROTURON	6.11	GLYPHOSATE	31.69	ISOPROTURON	6.74	DICHLORPROP-P	22.24	MCPA	25.90
	DICAMBA	5.47	METSULFURON	6.70	2,4-D	5.83	2,4-D	19.51	DICAMBA	8.50
	METSULFURON	2.41	2,4-D	4.75	DICAMBA	4.04	TRIBENURON	12.34	2,4-D	7.22
	FENOXAPROP-P	2.22	DICAMBA	3.03	DIFLUFENICAN	1.35	MECOPROP-P	6.19	TRITOSULFURON	3.80
Insecticides	CHLORPYRIFOS	54.66	DIMETHOATE	86.57	CHLORPYRIFOS	46.83	LAMBDA-CYHALOTHRIN	21.68	ZETA-CYPERMETHRIN	80.39
	CARBOFURAN	23.82	CYPERMETHRIN	7.33	DIMETHOATE	23.83	CYPERMETHRIN	19.19	ALPHA-CYPERMETHRIN	9.43
	DIMETHOATE	11.78	ALPHA-CYPERMETHRIN	4.30	OXYDEMETON-METHYL	16.86	ZETA-CYPERMETHRIN	19.19	DELTAMETHRIN	2.49
	CYPERMETHRIN	7.50	LAMBDA-CYHALOTHRIN	0.66	CYPERMETHRIN	4.68	OXYDEMETON-METHYL	16.79	THIACLOPRID	2.38
	ACETAMIPRID	0.90	TAU-FLUVALINATE	0.58	LAMBDA-CYHALOTHRIN	2.69	ESFENVALERATE	10.36	LAMBDA-CYHALOTHRIN	2.31
Growth regulators			CHLORMEQUAT	97.58	CHLORMEQUAT	62.52	CHLORMEQUAT	97.28	CHLORMEQUAT	76.80
			ETHEPHON	1.74	TRINEXAPAC-ETHYL	37.48	TRINEXAPAC-ETHYL	2.72	ETHEPHON	22.19
			TRINEXAPAC-ETHYL	0.59					MEPIQUAT	0.68
			MEPIQUAT	0.08					TRINEXAPAC-ETHYL	0.32

	LV	%	PL	%	RO	%	SI	%	SK	%
Fungicides	FENPROPIMORPH	17.62	SULFUR	23.76	CARBENDAZIM	60.15	FENPROPIDIN	19.51	TEBUCONAZOLE	10.84
	TEBUCONAZOLE	12.50	CARBENDAZIM	16.13	PROCHLORAZ	7.52	PROPICONAZOLE	16.31	CARBENDAZIM	10.59
	THIRAM	9.83	THIRAM	16.07	DIFENOCONAZOLE	7.39	THIRAM	"c"	THIOPHANATE-METHYL	9.83
	SPIROXAMINE	8.41	FENPROPIMORPH	7.31	THIRAM	6.20	FENPROPIMORPH	10.07	PROCHLORAZ	9.12
	EPOXICONAZOLE	8.06	FENPROPIDIN	4.63	THIOPHANATE-METHYL	6.12	AZOXYSTROBIN	7.01	PROPICONAZOLE	8.68
Herbicides	GLYPHOSATE	57.78	ISOPROTURON	36.65	2,4-D	81.43	CHLORTOLURON	57.90	MCPA	28.68
	MCPA	30.65	MCPA	17.64	TRIBENURON	7.84	ISOPROTURON	16.25	2,4-D	14.97
	2,4-D	4.46	2,4-D	13.65	BROMOXYNIL	3.25	BENTAZONE	5.73	GLYPHOSATE	10.69
	DICAMBA	1.95	CHLORTOLURON	8.04	Not identified	2.46	DIFLUFENICAN	2.80	DICAMBA	10.11
	AMIDOSULFURON	0.97	PENDIMETHALIN	6.58	CHLORSULFURON	1.54	2,4-D	2.59	ISOPROTURON	8.99
Insecticides	DIMETHOATE	94.12	DIMETHOATE	70.30	IMIDACLOPRID	40.58	LAMBDA-CYHALOTHRIN	32.33	CHLORPYRIFOS	41.74
	ALPHA-CYPERMETHRIN	3.20	PIRIMICARB	12.49	Not identified	14.96	ALPHA-CYPERMETHRIN	22.73	CYPERMETHRIN	16.77
	LAMBDA-CYHALOTHRIN	1.24	ALPHA-CYPERMETHRIN	7.12	CYPERMETHRIN	14.65	BETA-CYFLUTHRIN	13.05	DIMETHOATE	14.36
	ZETA-CYPERMETHRIN	0.66	CHLORPYRIFOS	6.14	DIMETHOATE	13.96	DELTAMETHRIN	5.56	LAMBDA-CYHALOTHRIN	10.72
	THIACLOPRID	0.28	CYPERMETHRIN	2.35	THIAMETHOXAM	8.97	CHLORPYRIFOS-METHYL	2.42	ALPHA-CYPERMETHRIN	7.14
Growth regulators	CHLORMEQUAT	90.27	CHLORMEQUAT	97.35	CHLORMEQUAT	100.00	TRINEXAPAC-ETHYL	58.60	CHLORMEQUAT	96.92
	ETHEPHON	6.28	TRINEXAPAC-ETHYL	1.81			CHLORMEQUAT	41.40	ETHEPHON	2.62
	MEPIQUAT	2.84	ETHEPHON	0.84					TRINEXAPAC-ETHYL	0.46
	TRINEXAPAC-ETHYL	0.61								

Table 2.5 Top-5 list of active substances used on wheat as a percentage of the total area of the crop treated.

	BG	%	EE	%	HR	%	HU	%	LT	%
Fungicides	TEBUCONAZOLE	35.62	TEBUCONAZOLE	18.82	PROPICONAZOLE	48.83	CARBENDAZIM	100.00	TEBUCONAZOLE	39.71
	CARBOXIN	22.39	EPOXICONAZOLE	10.70	EPOXICONAZOLE	43.12	CYPROCONAZOLE	100.00	THIRAM	20.99
	THIRAM	22.17	FENPROPIMORPH	10.12	CYPROCONAZOLE	42.81	PROPICONAZOLE	100.00	CYPROCONAZOLE	20.40
	DIFENOCONAZOLE	21.99	CYPROCONAZOLE	10.02	CARBENDAZIM	31.27	EPOXICONAZOLE	98.46	FLUDIOXONIL	18.86
	DINICONAZOLE	18.92	FLUDIOXONIL	7.75	TEBUCONAZOLE	23.34	TEBUCONAZOLE	98.46	PROPICONAZOLE	14.77
Herbicides	METSULFURON	43.88	MCPA	33.43	TRIASULFURON	49.36	TRIBENURON	100.00	AMIDOSULFURON	32.55
	TRIBENURON	20.57	AMIDOSULFURON	18.26	CHLORTOLURON	41.60	AMIDOSULFURON	96.80	IODOSULFURON	31.96
	Not identified	19.93	IODOSULFURON	17.75	DICAMBA	14.72	2,4-D	94.34	DICAMBA	23.06
	FLORASULAM	19.93	DICAMBA	17.39	AMIDOSULFURON	10.60	FLORASULAM	90.84	TRITOSULFURON	18.48
	2,4-D	18.01	FLORASULAM	16.38	2,4-D	9.57	TRIASULFURON	89.40	MCPA	17.37
Insecticides	CYPERMETHRIN	11.53	DIMETHOATE	5.74	LAMBDA-CYHALOTHRIN	33.35	LAMBDA-CYHALOTHRIN	96.50	ZETA-CYPERMETHRIN	11.37
	CHLORPYRIFOS	8.60	ALPHA-CYPERMETHRIN	4.67	ALPHA-CYPERMETHRIN	11.36	ESFENVALERATE	68.96	ALPHA-CYPERMETHRIN	6.65
	FIPRONIL	2.64	CYPERMETHRIN	2.61	DELTAMETHRIN	10.52	CYPERMETHRIN	65.22	LAMBDA-CYHALOTHRIN	4.03
	DIMETHOATE	2.20	LAMBDA-CYHALOTHRIN	1.61	CYPERMETHRIN	8.84	ZETA-CYPERMETHRIN	65.22	DELTAMETHRIN	3.89
	ACETAMIPRID	1.54		0.49	CHLORPYRIFOS	8.84	DELTAMETHRIN	45.47	BETA-CYFLUTHRIN	2.35
Growth regulators			CHLORMEQUAT	30.42	TRINEXAPAC-ETHYL	4.98	CHLORMEQUAT	85.81	CHLORMEQUAT	31.69
			TRINEXAPAC-ETHYL	1.62	CHLORMEQUAT	0.58	TRINEXAPAC-ETHYL	21.35	ETHEPHON	13.26
			ETHEPHON	1.10					TRINEXAPAC-ETHYL	1.37
			MEPIQUAT	0.05					MEPIQUAT	0.91

	LV	%	PL	%	RO	%	SI	%	SK	%
Fungicides	FLUDIOXONIL	34.65	CARBENDAZIM	69.23	TEBUCONAZOLE	47.62	PROPICONAZOLE	30.87	CYPROCONAZOLE	21.80
	TEBUCONAZOLE	29.05	THIRAM	57.21	CARBENDAZIM	22.83	TEBUCONAZOLE	29.60	Not identified	20.92
	CYPROCONAZOLE	28.98	PROPICONAZOLE	25.79	DIFENOCONAZOLE	17.43	CYPROCONAZOLE	28.97	PROPICONAZOLE	20.53
	PROTIOCONAZOLE	26.26	EPOXICONAZOLE	21.25	DINICONAZOLE	14.68	THIRAM	"c"	CARBENDAZIM	19.58
	FLUOXASTROBINE	25.52	TEBUCONAZOLE	19.82	THIOPHANATE-METHYL	10.26	FENPROPIDIN	19.98	TEBUCONAZOLE	19.57
Herbicides	TRIBENURON	29.61	ISOPROTURON	29.01	2,4-D	25.28	IODOSULFURON	51.73	DICAMBA	27.61
	FLORASULAM	28.86	2,4-D	25.40	TRIBENURON	13.88	AMIDOSULFURON	38.96	FLORASULAM	23.34
	AMIDOSULFURON	22.85	CHLORSULFURON	24.37	CHLORSULFURON	6.46	TRIASULFURON	21.43	2,4-D	22.11
	GLYPHOSATE	20.24	IODOSULFURON	21.33	METSULFURON	4.55	CHLORTOLURON	18.32	IODOSULFURON	20.92
	IODOSULFURON	18.16	DICAMBA	19.98	Not identified	3.87	ISOPROTURON	7.85	TRITOSULFURON	18.37
Insecticides	ALPHA-CYPERMETHRIN	4.04	ALPHA-CYPERMETHRIN	8.34	CYPERMETHRIN	14.00	LAMBDA-CYHALOTHRIN	22.56	LAMBDA-CYHALOTHRIN	11.13
	DIMETHOATE	3.47	DIMETHOATE	3.79	IMIDACLOPRID	6.39	ALPHA-CYPERMETHRIN	9.94	CYPERMETHRIN	4.45
	LAMBDA-CYHALOTHRIN	1.99	PIRIMICARB	1.08	Not identified	3.33	BETA-CYFLUTHRIN	6.63	ZETA-CYPERMETHRIN	3.90
	ZETA-CYPERMETHRIN	0.76	LAMBDA-CYHALOTHRIN	0.97	THIAMETHOXAM	1.30	DELTAMETHRIN	4.37	ALPHA-CYPERMETHRIN	3.33
	BETA-CYFLUTHRIN	0.53	CYPERMETHRIN	0.90	LAMBDA-CYHALOTHRIN	1.15	PIRIMIPHOS-METHYL	1.33	DELTAMETHRIN	1.85
Growth regulators	CHLORMEQUAT	34.88	CHLORMEQUAT	31.61	CHLORMEQUAT	0.07	TRINEXAPAC-ETHYL	0.64	CHLORMEQUAT	16.71
	ETHEPHON	10.23	TRINEXAPAC-ETHYL	8.04			CHLORMEQUAT	0.02	ETHEPHON	1.09
	MEPIQUAT	4.44	ETHEPHON	1.31					TRINEXAPAC-ETHYL	0.82
	TRINEXAPAC-ETHYL	2.54								

3. Indicators on pesticide use and risk

The past few decades have seen the development of a broad diversity of pesticide indicators. A review of the literature (VAN BOL, 2002) listed more that a hundred pesticide indicators. Three types of indicators have been identified according to their complexity and the type of data that were taken into account:

- Pesticide use indicators (PUI): total amounts or total number of sprayings on a given area;
- Pesticide risk indicators: risk induced for one particular category of risk. By definition, a PRI is a combination of hazard and exposure parameters;
- Pesticide impact assessment systems (PIAS): evaluation of the impact of a set of risks (involves not only toxicology but also ascribing relative importance to different categories of non-target organisms, which is outside the realm of objective science and enters the realm of value judgement).

PUI are very widely used and give an indication of the intensity of chemical crop protection. They are usually simple indicators, such as the volume of pesticide applied per hectare, and do not incorporate any measure of risk (toxicity).

In order to better control pesticide use, several countries have adopted a number of indicators based on the comparison between the quantities of pesticides applied and officially authorised doses. For instance, the Danish authorities have developed the concept of Frequency of Application, Germany is using a comparable Application Index, and various countries are using a similar Pesticide Treatment Frequency, Treatment Frequency or Treatment Frequency Index. Such indicators are regarded as indicators of the spraying intensity as well as overall indicators of the environmental impact of pesticides. It is assumed that there is a link between dose rates (and hence the effects on target organisms) and the effects on non-target organisms; however, this is not always the case.

Pesticide risk indicators are more complex and they typically integrate the dimensions of hazard (toxicity) and exposure, which are the two components of risk. Confronted with the broad diversity of pesticide risk indicators, the OECD and the European Commission have supported various programmes for the development of harmonised indicators. One of the main recent initiatives in this field was the HAIR project, financed under the EU's 6th research framework programme to develop a set of HArmonised environmental Indicators for pesticide Risk.

HAIR developed risk indicators in five areas:

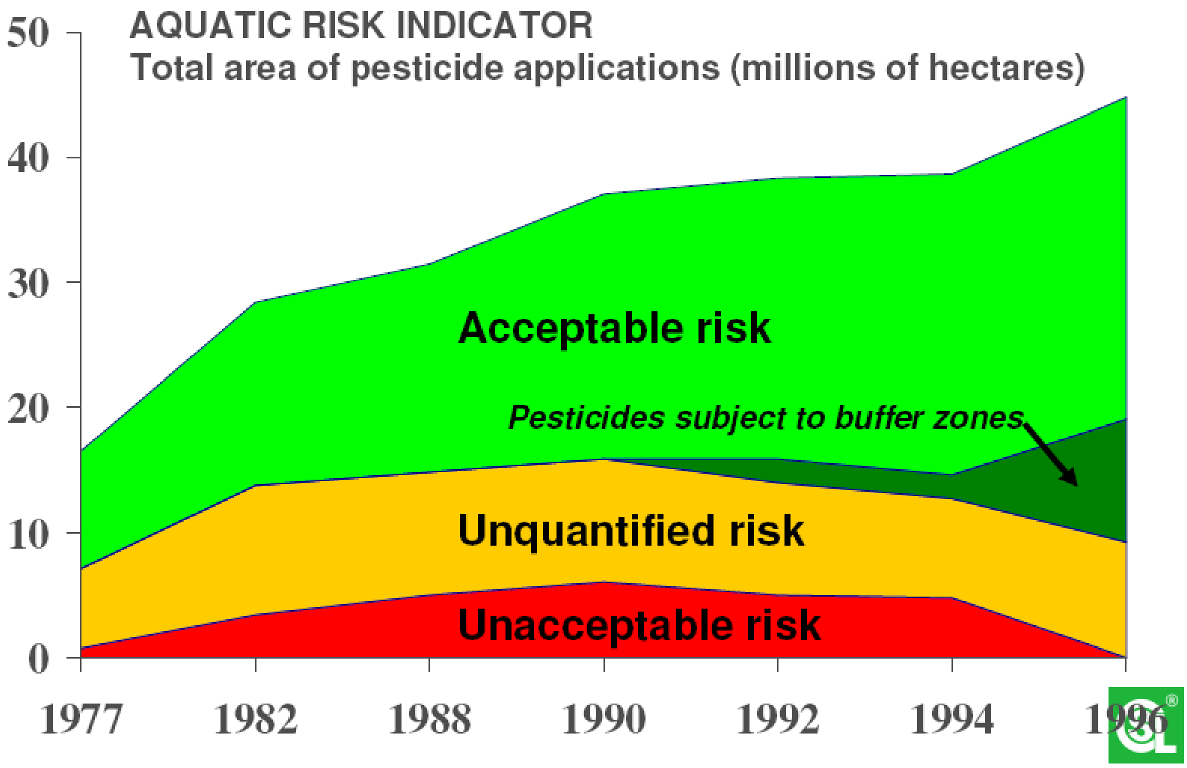
- Aquatic environment;
- Groundwater;
- Terrestrial environment;
- Consumers;
- Operator / Bystander.

In these five areas, risk is expressed via "Exposure to Toxicity Ratios" (ETRs) which compare predictable concentrations or exposure to the measure of the effects (e.g. LD50, LC50, NOEC). HAIR models work with relational databases which include pesticide usage data, compound properties, GIS information (soil, climate) and different transport and exposure models for the different compartments considered.

HAIR also integrates aggregation tools. Various levels of aggregation are possible in the different dimensions of the indicators: the component (e.g. terrestrial environment), active substances, space, time, and hazard types or events. For instance, an ETR can be calculated for a group of terrestrial organisms in different regions during a given year.

Since aggregations cannot be based on sound scientific justification, they should reflect policy orientations (e.g. interest in water protection, consumer health, etc.) and allow sufficient disaggregation to be able to identify and interpret the specific pesticide use patterns that influence the risk level. One way of aggregating the indicators is by comparing individual results to the (regulatory) threshold values for the risk considered. An example is the evolution of aquatic risk adopted by the UK pesticide forum, with risk being expressed in terms of the area treated where risk exceeds different levels of acceptability.

Figure 3.1 Model of presentation of the aquatic risk indicator adopted by the UK Pesticides Forum.



Annexes

1. Definitions and classification

Pesticide is a generic term covering:

(a) **plant protection products** as defined in Council Directive 91/414/EEC of 15 July 1991 concerning the placing of plant protection products on the market, and the new proposal for a Regulation COM(2006) 388 final;

(b) **biocidal products** (also called "biocides") as defined in Directive 98/8/EC of the European Parliament and of the Council of 16 February 1998 concerning the placing of biocidal products on the market.

Classification of plant protection products

For the purposes of these guidelines, and to allow meaningful comparisons of usage data between countries, plant protection products should be classified into the major groups of fungicides, herbicides, insecticides, molluscicides, growth regulators and “other pesticides”, within which usage of certain chemicals is specifically defined. Each group is outlined below.

General classification

• **Fungicides**

Include all chemicals used as fungicides, including the fungicidal elements of seed treatments, but excluding any non-fungicidal seed treatments. Because of the very large amounts applied to some commodities in some countries that may distort inter-country comparisons, sulphur should be reported individually within the fungicide category.

• **Herbicides**

Include all chemicals used as herbicides, including herbicides used for the purposes of desiccation (*e.g.* diquat & glufosinate-ammonium). Exclude sulphuric acid, however, which may form a major part of all herbicide usage in some countries (approx. 13,000 tonnes or 57% of all herbicides by weight applied in Great Britain in 1996).

• **Insecticides**

Include all chemicals used as insecticides, including the insecticidal elements of seed treatments, but excluding any non-insecticidal seed treatments. Include all nematicides, together with all acaricides such as fenbutatin oxide, cyhexatin, dicofol & tetradifon, not recognised as having any insecticidal activity. Exclude molluscicides, which will be reported separately in their own section.

• **Molluscicides**

Include all chemicals used as molluscicides, including the molluscicidal elements of seed treatments, but excluding any non-molluscicidal seed treatments.

• **Growth regulators**

Include all chemicals used as growth regulators, including carbaryl where this was specifically used for fruit thinning rather than insect control.

• **Other pesticides**

Include all chemicals not included in the above five categories, but are registered as plant protection products in one or several Member States.

Other plant protection products will include soil sterilants such as dazomet, metam-sodium, chloropicrin and 1,3-dichloropropene and chemicals such as dichlorophen and formaldehyde, together with the rodenticides and talpicides.

Harmonised list of active substances

In order to harmonise the presentation of data to be reported to Eurostat and to allow comparable aggregations by categories of products or groups of substances, a harmonised classification of active substances has been included in the proposal for a Regulation concerning statistics on plant protection products. Substances are identified according to the nomenclature used in the Pesticide Manual published by the British Crop Protection Council (BCPC, 2000) and by reference numbers published by the Chemical Abstracts Service Registry Numbers (CAS) and the Collaborative International Pesticides Analytical Council CIPAC). The chemical classes and categories of substances have been agreed by the Eurostat pesticide expert task force on the basis of the classification proposed by the Alan Wood Compendium of Pesticide Common Names (http://www.alanwood.net/pesticides).

MAJOR GROUPS & *Categories of products*	Group	Chemical Class	Active substances (BCPC)	CAS	CIPAC
			Common Nomenclature		
Fungicides and Bactericides: total.	**F0**				
Fungicides and Bactericides: total excluding sulphur.	**F0.1**				
Inorganic fungicides	**F1**				
	F1.1	COPPER COMPOUNDS	ALL COPPER COMPOUNDS		44
	F1.1		BORDEAUX MIXTURE	8011-63-0	44
	F1.1		COPPER HYDROXIDE	20427-59-2	44
	F1.1		COPPER OXYCHLORIDE	1332-40-7	44
	F1.1		TRIBASIC COPPER SULPHATE	1333-22-8	44
	F1.1		COPPER (I) OXIDE	1319-39-1	44
	F1.1		OTHER COPPER SALTS		44
	F1.2	INORGANIC SULFUR	SULFUR	7704-34-9	18
	F1.3	OTHER INORGANIC FUNGICIDES	ZZ-OTHER-INORG-FUNGICIDES		
Fungicides based on carbamates and dithiocarbamates	**F2**				
	F2.1	CARBANILATE FUNGICIDES	DIETHOFENCARB	87130-20-9	513
	F2.2	CARBAMATE FUNGICIDES	PROPAMOCARB	24579-73-5	399
	F2.2		IPROVALICARB	140923-17-7	620
	F2.3	DITHIOCARBAMATE FUNGICIDES	MANCOZEB	8018-01-7	34
	F2.3		MANEB	12427-38-2	61
	F2.3		METIRAM	9006-42-2	478
	F2.3		PROPINEB	12071-83-9	177
	F2.3		THIRAM	137-26-8	24
	F2.3		ZIRAM	137-30-4	31
Fungicides based on benzimidazoles	**F3**				
	F3.1	BENZIMIDAZOLE FUNGICIDES	CARBENDAZIM	10605-21-7	263
	F3.1		FUBERIDAZOLE	3878-19-1	525
	F3.1		THIABENDAZOLE	148-79-8	323
	F3.1		THIOPHANATE-METHYL	23564-05-8	262
Fungicides based on imidazoles and triazoles	**F4**				
	F4.1	CONAZOLE FUNGICIDES	BITERTANOL	55179-31-2	386
	F4.1		BROMUCONAZOLE	116255-48-2	680
	F4.1		CYPROCONAZOLE	94361-06-5	600
	F4.1		DIFENOCONAZOLE	119446-68-3	687

	F4.1		DINICONAZOLE	83657-24-3	690
	F4.1		EPOXICONAZOLE	106325-08-0	609
	F4.1		ETRIDIAZOLE	2593-15-9	518
	F4.1		FENBUCONAZOLE	114369-43-6	694
	F4.1		FLUQUINCONAZOLE	136426-54-5	474
	F4.1		FLUSILAZOLE	85509-19-9	435
	F4.1		FLUTRIAFOL	76674-21-0	436
	F4.1		HEXACONAZOLE	79983-71-4	465
	F4.1		IMAZALIL (ENILCONAZOLE)	58594-72-2	335
	F4.1		METCONAZOLE	125116-23-6	706
	F4.1		MYCLOBUTANIL	88671-89-0	442
	F4.1		PENCONAZOLE	66246-88-6	446
	F4.1		PROPICONAZOLE	60207-90-1	408
	F4.1		TEBUCONAZOLE	107534-96-3	494
	F4.1		TETRACONAZOLE	112281-77-3	726
	F4.1		TRIADIMENOL	55219-65-3	398
	F4.1		TRICYCLAZOLE	41814-78-2	547
	F4.1		TRIFLUMIZOLE	99387-89-0	730
	F4.1		TRITICONAZOLE	131983-72-7	652
	F4.2	IMIDAZOLE FUNGICIDES	CYAZOFAMIDE	120116-88-3	653
	F4.2		FENAMIDONE	161326-34-7	650
	F4.2		TRIAZOXIDE	72459-58-6	729
Fungicides based on morpholines	**F5**				
	F5.1	MORPHOLINE FUNGICIDES	DIMETHOMORPH	110488-70-5	483
	F5.1		DODEMORPH	1593-77-7	300
	F5.1		FENPROPIMORPH	67564-91-4	427
Other fungicides	**F6**				
	F6.1	ALIPHATIC NITROGEN FUNGICIDES	CYMOXANIL	57966-95-7	419
	F6.1		DODINE	2439-10-3	101
	F6.1		GUAZATINE	108173-90-6	361
	F6.2	AMIDE FUNGICIDES	BENALAXYL	71626-11-4	416
	F6.2		BOSCALID	188425-85-6	673
	F6.2		FLUTOLANIL	66332-96-5	524
	F6.2		MEPRONIL	55814-41-0	533
	F6.2		METALAXYL	57837-19-1	365
	F6.2		METALAXYL-M	70630-17-0	580
	F6.2		PROCHLORAZ	67747-09-5	407
	F6.2		SILTHIOFAM	175217-20-6	635
	F6.2		TOLYLFLUANID	731-27-1	275
	F6.2		ZOXAMIDE	156052-68-5	640
	F6.3	ANILIDE FUNGICIDES	CARBOXIN	5234-68-4	273
	F6.3		FENHEXAMID	126833-17-8	603
	F6.4	ANTIBIOTIC FUNGICIDES-BACTERICIDES	KASUGAMYCIN	6980-18-3	703
	F6.4		POLYOXINS	11113-80-7	710
	F6.4		STREPTOMYCIN	57-92-1	312
	F6.5	AROMATIC FUNGICIDES	CHLOROTHALONIL	1897-45-6	288
	F6.5		DICLORAN	99-30-9	150
	F6.6	DICARBOXIMIDE FUNGICIDES	IPRODIONE	36734-19-7	278
	F6.6		PROCYMIDONE	32809-16-8	383
	F6.7	DINITROANILINE FUNGICIDES	FLUAZINAM	79622-59-6	521
	F6.8	DINITROPHENOL FUNGICIDES	DINOCAP	39300-45-3	98
	F6.9	ORGANOPHOSPHORUS FUNGICIDES	FOSETYL	15845-66-6	384
	F6.9		TOLCLOFOS-METHYL	57018-04-9	479
	F6.10	OXAZOLE FUNGICIDES	HYMEXAZOL	10004-44-1	528
	F6.10		FAMOXADONE	131807-57-3	594
	F6.10		VINCLOZOLIN	50471-44-8	280
	F6.11	PHENYLPYRROLE FUNGICIDES	FLUDIOXONIL	131341-86-1	522
	F6.12	PHTHALIMIDE FUNGICIDES	CAPTAN	133-06-2	40
	F6.12		FOLPET	133-07-3	75
	F6.13	PYRIMIDINE FUNGICIDES	BUPIRIMATE	41483-43-6	261
	F6.13		CYPRODINIL	121552-61-2	511
	F6.13		FENARIMOL	60168-88-9	380
	F6.13		MEPANIPYRIM	110235-47-7	611
	F6.13		PYRIMETHANIL	53112-28-0	714
	F6.14	QUINOLINE FUNGICIDES	QUINOXYFEN	124495-18-7	566
	F6.14		8-HYDROXYQUINOLINE SULFATE	134-31-6	677
	F6.15	QUINONE FUNGICIDES	DITHIANON	3347-22-6	153

	F6.16	STROBILURINE FUNGICIDES	AZOXYSTROBIN	131860-33-8	571
	F6.16		DIMOXYSTROBIN	149961-52-4	739
	F6.16		KRESOXIM-METHYL	143390-89-0	568
	F6.16		PICOXYSTROBINE	117428-22-5	628
	F6.16		PYRACLOSTROBINE	175013-18-0	657
	F6.16		TRIFLOXYSTROBINE	141517-21-7	617
	F6.17	UREA FUNGICIDES	PENCYCURON	66063-05-6	402
	F6.18	UNCLASSIFIED FUNGICIDES	ACIBENZOLAR	126448-41-7	597
	F6.18		BENZOIC ACID	65-85-0	622
	F6.18		DICHLOROPHEN	97-23-4	325
	F6.18		FENPROPIDIN	67306-00-7	520
	F6.18		2-PHENYPHENOL	90-43-7	246
	F6.18		SPIROXAMINE	118134-30-8	572
	F6.19	OTHER-FUNGICIDES	ZZ-OTHER-FUNGICIDES		
Herbicides, Haulm Destructors and Moss Killers: total.	**H0**				
Herbicides, Haulm Destructors and Moss Killers: total excluding sulfuric acid.	**H0**				
Herbicides based on phenoxy-phytohormones	**H1**				
	H1.1	PHENOXY HERBICIDES	2,4-D	94-75-7	1
	H1.1		2,4-DB	94-82-6	83
	H1.1		DICHLORPROP-P	15165-67-0	476
	H1.1		MCPA	94-74-6	2
	H1.1		MCPB	94-81-5	50
	H1.1		MECOPROP	7085-19-0	51
	H1.1		MECOPROP-P	16484-77-8	475
Herbicides based on triazines and triazinones	**H2**				
	H2.1	METHYLTHIOTRIAZINE HERBICIDES	METHOPROTRYNE	841-06-5	94
	H2.2	TRIAZINE HERBICIDES	SIMETRYN	1014-70-6	179
	H2.2		TERBUTHYLAZINE	5915-41-3	234
	H2.3	TRIAZINONE HERBICIDES	METAMITRON	41394-05-2	381
	H2.3		METRIBUZIN	21087-64-9	283
Herbicides based on amides and anilides	**H3**				
	H3.1	AMIDE HERBICIDES	DIMETHENAMID	87674-68-8	638
	H3.1		FLUPOXAM	119126-15-7	8158
	H3.1		ISOXABEN	82558-50-7	701
	H3.1		NAPROPAMIDE	15299-99-7	271
	H3.1		PROPYZAMIDE	23950-58-5	315
	H3.2	ANILIDE HERBICIDES	DIFLUFENICAN	83164-33-4	462
	H3.2		FLORASULAM	145701-23-1	616
	H3.2		FLUFENACET	142459-58-3	588
	H3.2		METOSULAM	139528-85-1	707
	H3.2		METAZACHLOR	67129-08-2	411
	H3.2		PROPANIL	709-98-8	205
	H3.3	CHLOROACETANILIDE HERBICIDES	ACETOCHLOR	34256-82-1	496
	H3.3		DIMETHACHLOR	50563-36-5	688
	H3.3		PRETILACHLOR	51218-49-6	711
	H3.3		PROPACHLOR	1918-16-7	176
Herbicides based on carbamates and bis-carbamates	**H4**				
	H4.1	BIS-CARBAMATE HERBICIDES	CHLORPROPHAM	101-21-3	43
	H4.1		DESMEDIPHAM	13684-56-5	477
	H4.1		PHENMEDIPHAM	13684-63-4	77
	H4.2	CARBAMATE HERBICIDES	ASULAM	3337-71-1	240
	H4.2		CARBETAMIDE	16118-49-3	95
Herbicides based on dinitroaniline derivatives	**H5**				
	H5.1	DINITROANILINE HERBICIDES	BENFLURALIN	1861-40-1	285

	H5.1		BUTRALIN	33629-47-9	504
	H5.1		ETHALFLURALIN	55283-68-6	516
	H5.1		ORYZALIN	19044-88-3	537
	H5.1		PENDIMETHALIN	40487-42-1	357
	H5.1		TRIFLURALIN	2582-09-8	183
Herbicides based on derivatives of urea, of uracil or of sulphonylurea	**H6**				
	H6.1	SULFONYLUREA HERBICIDES	AMIDOSULFURON	120923-37-7	515
	H6.1		AZIMSULFURON	120162-55-2	584
	H6.1		BENSULFURON	99283-01-9	502
	H6.1		CHLORSULFURON	64902-72-3	391
	H6.1		CINOSULFURON	94593-91-6	507
	H6.1		ETHOXYSULFURON	126801-58-9	591
	H6.1		FLAZASULFURON	104040-78-0	595
	H6.1		FLUPYRSULFURON	150315-10-9	577
	H6.1		FORAMSULFURON	173159-57-4	659
	H6.1		IMAZOSULFURON	122548-33-8	590
	H6.1		IODOSULFURON	185119-76-0	634
	H6.1		MESOSULFURON	400852-66-6	663
	H6.1		METSULFURON	74223-64-6	441
	H6.1		NICOSULFURON	111991-09-4	709
	H6.1		OXASULFURON	144651-06-9	626
	H6.1		PRIMISULFURON	113036-87-6	712
	H6.1		PROSULFURON	94125-34-5	579
	H6.1		RIMSULFURON	122931-48-0	716
	H6.1		SULFOSULFURON	141776-32-1	601
	H6.1		THIFENSULFURON	79277-67-1	452
	H6.1		TRIASULFURON	82097-50-5	480
	H6.1		TRIBENURON	106040-48-6	546
	H6.1		TRIFLUSULFURON	135990-29-3	731
	H6.1		TRITOSULFURON	142469-14-5	735
	H6.2	URACIL HERBICIDES	LENACIL	2164-08-1	163
	H6.3	UREA HERBICIDES	CHLORTOLURON	15545-48-9	217
	H6.3		DIURON	330-54-1	100
	H6.3		FLUOMETURON	2164-17-2	159
	H6.3		ISOPROTURON	34123-59-6	336
	H6.3		LINURON	330-55-2	76
	H6.3		METHABENZTHIAZURON	18691-97-9	201
	H6.3		METOBROMURON	3060-89-7	168
	H6.3		METOXURON	19937-59-8	219
Other herbicides	**H7**				
	H7.1	ARYLOXYPHENOXYPROPIONIC HERBICIDES	CLODINAFOP	114420-56-3	683
	H7.1		CYHALOFOP	122008-85-9	596
	H7.1		DICLOFOP	40843-25-2	358
	H7.1		FENOXAPROP-P	113158-40-0	484
	H7.1		FLUAZIFOP-P-BUTYL	79241-46-6	395
	H7.1		HALOXYFOP	69806-34-4	438
	H7.1		HALOXYFOP-R	72619-32-0	526
	H7.1		PROPAQUIZAFOP	111479-05-1	713
	H7.1		QUIZALOFOP	76578-12-6	429
	H7.1		QUIZALOFOP-P	94051-08-8	641
	H7.2	BENZOFURANE HERBICIDES	ETHOFUMESATE	26225-79-6	233
	H7.3	BENZOIC-ACID HERBICIDES	CHLORTHAL	2136-79-0	328
	H7.3		DICAMBA	1918-00-9	85
	H7.4	BIPYRIDYLIUM HERBICIDES	DIQUAT	85-00-7	55
	H7.4		PARAQUAT	4685-14-7	56
	H7.5	CYCLOHEXANEDIONE HERBICIDES	CLETHODIM	99129-21-2	508
	H7.5		CYCLOXYDIM	101205-02-1	510
	H7.5		TEPRALOXYDIM	149979-41-9	608
	H7.5		TRALKOXYDIM	87820-88-0	544
	H7.6	DIAZINE HERBICIDES	PYRIDATE	55512-33-9	447
	H7.7	DICARBOXIMIDE HERBICIDES	CINIDON-ETHYL	142891-20-1	598
	H7.7		FLUMIOXAZIN	103361-09-7	578
	H7.8	DIPHENYL ETHER HERBICIDES	ACLONIFEN	74070-46-5	498
	H7.8		BIFENOX	42576-02-3	413
	H7.8		NITROFEN	1836-75-5	170
	H7.8		OXYFLUORFEN	42874-03-3	538
	H7.9	IMIDAZOLINONE HERBICIDES	IMAZAMETHABENZ	100728-84-5	529

	H7.9		IMAZAMOX	114311-32-9	619
	H7.9		IMAZETHAPYR	81335-77-5	700
	H7.10	INORGANIC HERBICIDES	AMMONIUM SULFAMATE	7773-06-0	679
	H7.10		CHLORATES	7775-09-9	7
	H7.11	ISOXAZOLE HERBICIDES	ISOXAFLUTOLE	141112-29-0	575
	H7.12	MORPHACTIN HERBICIDES	FLURENOL	467-69-6	304
	H7.13	NITRILE HERBICIDES	BROMOXYNIL	1689-84-5	87
	H7.13		DICHLOBENIL	1194-65-6	73
	H7.13		IOXYNIL	1689-83-4	86
	H7.14	ORGANOPHOSPHORUS HERBICIDES	GLUFOSINATE	51276-47-2	437
	H7.14		GLYPHOSATE	1071-83-6	284
	H7.15	PHENYLPYRAZOLE HERBICIDES	PYRAFLUFEN	129630-19-9	605
	H7.16	PYRIDAZINONE HERBICIDES	CHLORIDAZON	1698-60-8	111
	H7.16		FLURTAMONE	96525-23-4	569
	H7.17	PYRIDINECARBOXAMIDE HERBICIDES	PICOLINAFEN	137641-05-5	639
	H7.18	PYRIDINECARBOXYLIC-ACID HERBICIDES	CLOPYRALID	1702-17-6	455
	H7.18		PICLORAM	1918-02-1	174
	H7.19	PYRIDYLOXYACETIC-ACID HERBICIDES	FLUROXYPYR	69377-81-7	431
	H7.19		TRICLOPYR	55335-06-3	376
	H7.20	QUINOLINE HERBICIDES	QUINCLORAC	84087-01-4	493
	H7.20		QUINMERAC	90717-03-6	563
	H7.21	THIADIAZINE HERBICIDES	BENTAZONE	25057-89-0	366
	H7.22	THIOCARBAMATE HERBICIDES	EPTC	759-94-4	155
	H7.22		MOLINATE	2212-67-1	235
	H7.22		PROSULFOCARB	52888-80-9	539
	H7.22		THIOBENCARB	28249-77-6	388
	H7.22		TRI-ALLATE	2303-17-5	97
	H7.23	TRIAZOLE HERBICIDES	AMITROL	61-82-5	90
	H7.24	TRIAZOLINONE HERBICIDES	CARFENTRAZONE	128639-02-1	587
	H7.25	TRIAZOLONE HERBICIDES	PROPOXYCARBAZONE	145026-81-9	655
	H7.26	TRIKETONE HERBICIDES	MESOTRIONE	104206-82-8	625
	H7.26		SULCOTRIONE	99105-77-8	723
	H7.27	UNCLASSIFIED HERBICIDES	CLOMAZONE	81777-89-1	509
	H7.27		FLUROCHLORIDONE	61213-25-0	430
	H7.27		QUINOCLAMINE	2797-51-5	648
	H7.27		METHAZOLE	20354-26-1	369
	H7.27		OXADIARGYL	39807-15-3	604
	H7.27		OXADIAZON	19666-30-9	213
	H7.28	OTHER HERBICIDES-HAULM DESTRUCTOR-MOSS KILLER	ZZ-OTHER-HERBICIDES-HAULM DESTRUCTOR-MOSS KILLER		
Insecticides and Acaricides, total:	**I0**				
Insecticides based on pyrethroids	**I1**				
	I1.1	PYRETHROID INSECTICIDES	ACRINATHRIN	101007-06-1	678
	I1.1		ALPHA-CYPERMETHRIN	67375-30-8	454
			BETA-CYFLUTHRIN	68359-37-5	482
	I1.1		BETA-CYPERMETHRIN	65731-84-2	632
	I1.1		BIFENTHRIN	82657-04-3	415
	I1.1		CYFLUTHRIN	68359-37-5	385
	I1.1		CYPERMETHRIN	52315-07-8	332
	I1.1		DELTAMETHRIN	52918-63-5	333
	I1.1		ESFENVALERATE	66230-04-4	481
	I1.1		ETOFENPROX	80844-07-1	471
	I1.1		GAMMA-CYHALOTHRIN	76703-62-3	768
	I1.1		LAMBDA-CYHALOTHRIN	91465-08-6	463
	I1.1		TAU-FLUVALINATE	102851-06-9	432
	I1.1		TEFLUTHRIN	79538-32-2	451
	I1.1		ZETA-CYPERMETHRIN	52315-07-8	733
Insecticides based on chlorinated hydrocarbons	**I2**				
	I2.1	ORGANOCHLORINE INSECTICIDES	DICOFOL	115-32-2	123
	I2.1		TETRASUL	2227-13-6	114
Insecticides based on carbamates	**I3**				

and oxime-carbamate					
	I3.1	OXIME-CARBAMATE INSECTICIDES	METHOMYL	16752-77-5	264
	I3.1		OXAMYL	23135-22-0	342
	I3.2	CARBAMATE INSECTICIDES	BENFURACARB	82560-54-1	501
	I3.2		CARBARYL	63-25-2	26
	I3.2		CARBOFURAN	1563-66-2	276
	I3.2		CARBOSULFAN	55285-14-8	417
	I3.2		FENOXYCARB	79127-80-3	425
	I3.2		FORMETANATE	22259-30-9	697
	I3.2		METHIOCARB	2032-65-7	165
	I3.2		PIRIMICARB	23103-98-2	231
Insecticides based on organophosphates	**I4**				
	I4.1	ORGANOPHOSPHORUS INSECTICIDES	AZINPHOS-METHYL	86-50-0	37
	I4.1		CADUSAFOS	95465-99-9	682
	I4.1		CHLORPYRIFOS	2921-88-2	221
	I4.1		CHLORPYRIFOS-METHYL	5589-13-0	486
	I4.1		COUMAPHOS	56-72-4	121
	I4.1		DIAZINON	333-41-5	15
	I4.1		DICHLORVOS	62-73-7	11
	I4.1		DIMETHOATE	60-51-5	59
	I4.1		ETHOPROPHOS	13194-48-4	218
	I4.1		FENAMIPHOS	22224-92-6	692
	I4.1		FENITROTHION	122-14-5	35
	I4.1		FOSTHIAZATE	98886-44-3	585
	I4.1		ISOFENPHOS	25311-71-1	412
	I4.1		MALATHION	121-75-5	12
	I4.1		METHAMIDOPHOS	10265-92-6	355
	I4.1		NALED	300-76-5	195
	I4.1		OXYDEMETON-METHYL	301-12-2	171
	I4.1		PHOSALONE	2310-17-0	109
	I4.1		PHOSMET	732-11-6	318
	I4.1		PHOXIM	14816-18-3	364
	I4.1		PIRIMIPHOS-METHYL	29232-93-7	239
	I4.1		TRICHLORFON	52-68-6	68
Biological and botanical product based Insecticides	**I5**				
	I5.1	BIOLOGICAL INSECTICIDES	AZADIRACHTIN	11141-17-6	627
	I5.1		NICOTINE	54-11-5	8
	I5.1		PYRETHRINS	8003-34-7	32
	I5.1		ROTENONE	83-79-4	38
Other insecticides	**I6**				
	I6.1	ANTIBIOTIC INSECTICIDES	ABAMECTIN	71751-41-2	495
	I6.1		MILBEMECTIN	51596-10-2 51596-11-3	660
	I6.1		SPINOSAD	168316-95-8	636
	I6.3	BENZOYLUREA INSECTICIDES	DIFLUBENZURON	35367-38-5	339
	I6.3		FLUFENOXURON	101463-69-8	470
	I6.3		HEXAFLUMURON	86479-06-3	698
	I6.3		LUFENURON	103055-07-8	704
	I6.3		NOVALURON	116714-46-6	672
	I6.3		TEFLUBENZURON	83121-18-0	450
	I6.3		TRIFLUMURON	64628-44-0	548
	I6.4	CARBAZATE INSECTICIDES	BIFENAZATE	149877-41-8	736
	I6.5	DIAZYLHYDRAZINE INSECTICIDES	METHOXYFENOZIDE	161050-58-4	656
	I6.5		TEBUFENOZIDE	112410-23-8	724
	I6.6	INSECT GROWTH REGULATORS	BUPROFEZIN	69327-76-0	681
	I6.6		CYROMAZINE	66215-27-8	420
	I6.6		HEXYTHIAZOX	78587-05-0	439
	I6.7	INSECT PHEROMONES	(E,Z)-9-DODECENYL ACETATE	35148-19-7	422
	I6.8	NITROGUANIDINE INSECTICIDES	CLOTHIANIDIN	210880-92-5	738
	I6.8		THIAMETHOXAM	153719-23-4	637
	I6.9	ORGANOTIN INSECTICIDES	AZOCYCLOTIN	41083-11-8	404

	I6.9		CYHEXATIN	13121-70-5	289
	I6.9		FENBUTATIN OXIDE	13356-08-6	359
	I6.10	OXADIAZINE INSECTICIDES	INDOXACARB	173584-44-6	612
	I6.11	PHENYL-ETHER INSECTICIDES	PYRIPROXYFEN	95737-68-1	715
	I6.12	PYRAZOLE (PHENYL-) INSECTICIDES	FENPYROXIMATE	134098-61-6	695
	I6.12		FIPRONIL	120068-37-3	581
	I6.12		TEBUFENPYRAD	119168-77-3	725
	I6.13	PYRIDINE INSECTICIDES	PYMETROZINE	123312-89-0	593
	I6.14	PYRIDYLMETHYLAMINE INSECTICIDES	ACETAMIPRID	135410-20-7	649
	I6.14		IMIDACLOPRID	138261-41-3	582
	I6.14		THIACLOPRID	111988-49-9	631
	I6.15	SULFITE ESTER INSECTICIDES	PROPARGITE	2312-35-8	216
	I6.16	TETRAZINE INSECTICIDES	CLOFENTEZINE	74115-24-5	418
	I6.17	TETRONIC ACID INSECTICIDES	SPIRODICLOFEN	148477-71-8	737
	I6.18	(CARBAMOYL-) TRIAZOLE INSECTICIDES	TRIAZAMATE	112143-82-5	728
	I6.19	UREA INSECTICIDES	DIAFENTHIURON	80060-09-9	8097
	I6.20	UNCLASSIFIED INSECTICIDES	ETOXAZOLE	153233-91-1	623
	I6.20		FENAZAQUIN	120928-09-8	693
	I6.20		PYRIDABEN	96489-71-3	583
	I6.21	OTHER INSECTICIDES-ACARICIDES	ZZ-OTHER-INSECTICIDES-ACARICIDES		
Molluscicides, total:	**M0**				
Molluscicides	**M1**				
	M1.1	CARBAMATE MOLLUSCICIDE	THIODICARB	59669-26-0	543
	M1.2	UNCLASSIFIED MOLLUSCICIDES	FERRIC PHOSPHATE	10045-86-0	629
	M1.2		METALDEHYDE	108-62-3	62
	M1.3	OTHER MOLLUSCICIDES	ZZ-OTHER-MOLLUSCICIDES		
Plant Growth Regulators, total:	**PGR0**				
Physiological Plant growth regulators	**PGR1**				
	PGR1.1	PHYSIOLOGICAL PLANT GROWTH REGULATORS	CHLORMEQUAT	999-81-5	143
	PGR1.1		CYCLANILIDE	113136-77-9	586
	PGR1.1		DAMINOZIDE	1596-84-5	330
	PGR1.1		DIMETHIPIN	55290-64-7	689
	PGR1.1		DIPHENYLAMINE	122-39-4	460
	PGR1.1		ETHEPHON	16672-87-0	373
	PGR1.1		ETHOXYQUIN	91-53-2	517
	PGR1.1		FLORCHLORFENURON	68157-60-8	633
	PGR1.1		FLURPRIMIDOL	56425-91-3	696
	PGR1.1		IMAZAQUIN	81335-37-7	699
	PGR1.1		MALEIC HYDRAZIDE	51542-52-0	310
	PGR1.1		MEPIQUAT	24307-26-4	440
	PGR1.1		1-METHYLCYCLOPROPENE	3100-04-7	767
	PGR1.1		PACLOBUTRAZOL	76738-62-0	445
	PGR1.1		PROHEXADIONE-CALCIUM	127277-53-6	567
	PGR1.1		SODIUM 5-NITROGUAIACOLATE	67233-85-6	718
	PGR1.1		SODIUM O-NITROPHENOLATE	824-39-5	720
	PGR1.1		TRINEXAPAC-ETHYL	95266-40-3	8349
Anti-sprouting products	**PGR2**				
	PGR2.2	ANTISPROUTING PRODUCTS	CARVONE	99-49-0	602
	PGR2.2		CHLORPROPHAM	101-21-3	43
Other plant growth regulators	**PGR3**				
	PGR3.1	OTHER PLANT GROWTH REGULATORS	ZZ-OTHER-PGR		
Other Plant Protection Products, total:	**ZR0**				
Mineral oils	**ZR1**				
	ZR1.1	MINERAL OIL	PETROLEUM OILS	64742-55-8	29
Vegetal oils	**ZR2**				
	ZR2.1	VEGETAL OIL	TAR OILS		30
Soil sterilants	**ZR3**				

(incl. Nematicides)					
	ZR3.1	METHYL BROMIDE	METHYL BROMIDE	74-83-9	128
	ZR3.2	UNCLASSIFIED SOIL STERILANTS	CHLOROPICRIN	76-06-2	298
	ZR3.2		DAZOMET	533-74-4	146
	ZR3.2		1,3-DICHLOROPROPENE	542-75-6	675
	ZR3.2		METAM-SODIUM	137-42-8	20
	ZR3.3	OTHER SOIL STERILANTS	ZZ-OTHER-SOIL-STERILANTS		
Rodenticides	**ZR4**				
	ZR4.1	RODENTICIDES	BRODIFACOUM	56073-10-0	370
	ZR4.1		BROMADIOLONE	28772-56-7	371
	ZR4.1		CHLORALOSE	15879-93-3	249
	ZR4.1		CHLOROPHACINONE	3691-35-8	208
	ZR4.1		COUMATETRALYL	5836-29-3	189
	ZR4.1		DIFENACOUM	56073-07-5	514
	ZR4.1		DIFETHIALONE	104653-34-1	549
	ZR4.1		FLOCOUMAFEN	90035-08-8	453
	ZR4.1		WARFARIN	81-81-2	70
	ZR4.2	OTHER RODENTICIDES	ZZ-OTHER-RODENTICIDES		
All other plant protection products	**ZR5**				
	ZR5.1	DISINFECTANTS	ZZ-OTHER-DISINFECTANTS		
	ZR5.2	OTHER PLANT PROTECTION PRODUCTS	ZZ-OTHER-PPP		
Total Plant Protection Products:	**ZZ0**				

2. Methodological notes

Details of data sources

The guidelines for the Collection of Pesticide Usage Statistics within Agriculture and Horticulture published by Eurostat in 1999 as an internal working document, and the results of the pilot surveys on the use of pesticides carried out in the framework of the 2005 Multi-Beneficiary and Transition Facility Statistical Co-operation Programmes on which this methodological paper is based, can be found on the CIRCA website dedicated to pesticide statistics: http://circa.europa.eu/Public/irc/dsis/pip/library?l=/indicators_pesticides

The main results of these surveys in terms of quantities of active substances used per crop and main categories of products are also available in the domain dedicated to ENVIRONMENT STATISTICS under the title AGRICULTURE AND ENVIRONMENT. Data on consumption and sales of pesticides are currently collected from Member States and EEA Countries on a voluntary basis. As a consequence, data are still very fragmentary and difficult to compare between the different countries. This project was a first attempt to collect representative data on pesticide use at national level in the various countries on the basis of a harmonised methodology.
In order to cope with this lack of information, the Commission adopted on 11 December 2006 a proposal for a Regulation of the European Parliament and of the Council concerning statistics on plant protection products (COM(2006) 778 final), which is currently being discussed in the Council and the European Parliament.
This proposal for a Regulation aims to provide the data necessary to measure the progress of the thematic strategy for the sustainable use of pesticides as presented by the Commission to the European Parliament and Council in a Communication (COM(2006) 372 final) and a proposal for Directive of the European Parliament and of the Council establishing a framework for Community action to achieve a sustainable use of pesticides (COM(2006) 373 final).

Definitions of variables and indicators

Pesticide is a broad concept covering plant protection products which are mainly used by farmers to protect their crops (covered by Directive 91/414/EEC) and biocidal products which are used for a very large diversity of purposes (covered by Directive 98/8/EC). This paper, like the statistics published by Eurostat on this issue, concerns plant protection products exclusively. The data refer to amounts of active substances (in kg), which are the components in a commercial product that cause the desired effect on target organisms (fungi, weeds, pests, etc.)
Individual active substances can be grouped in different categories according to their main function and to their chemical properties. The major functional groups covered by this publication are fungicides, herbicides, insecticides, and growth regulators. Within these groups, active substances can also be grouped in categories of products and chemical classes according to a harmonised classification presented in Annex III of the proposal for a Regulation concerning statistics on plant protection products (COM(2006) 778).
The areas referred to in this paper correspond to the physical areas in which the relevant crops are cultivated (essentially wheat, except for Malta where the area concerns all the crops covered). In general, the area cultivated was grossed up at national level except when the size of the survey was insufficient to allow such an extrapolation.

The main indicator presented in this paper is the average intensity of treatment, which is the ratio between the quantity of active substance (in kg) and the total area under wheat.

Abbreviations and symbols

EU	European Union		
BG	Bulgaria	EE	Estonia
CY	Cyprus	LV	Latvia
LT	Lithuania	HU	Hungary
HR	Croatia	MT	Malta
PL	Poland	RO	Romania
SI	Slovenia	SK	Slovakia
TR	Turkey	UK	United Kingdom

Kg	Kilogram
Ha	Hectare
AS	Active substance
F	Fungicide
H	Herbicide
I	Insecticide
GR	Growth regulator
LC50	Lethal concentration for 50% of the exposed population
LD50	Lethal doses for 50% of the exposed population
NOEC	No observed effect concentration
FADN	Farm Accountancy Data Network
FR	Farm registers
FSS	Farm Structure survey
IACS	Integrated Administration and Control System

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COM(2006) 388 final. Proposal for a Regulation of the European Parliament and of the Council concerning the placing of plant protection products on the market, 12.07.2006.

Council Directive 91/414/EEC of 15 July 1991 concerning the placing of plant protection products on the market. OJ L 230, 19.8.1991, p. 1.

Directive 98/8/EC of the European Parliament and of the Council of 16 February 1998 concerning the placing of biocidal products on the market. OJ L 123, 24.4.1998, p. 1.

Links

ADAS: http://www.adas.co.uk
HAIR: http://www.rivm.nl/rvs/overige/risbeoor/Modellen/HAIR.jsp
FAO: http://www.fao.org/corp/statistics
OECD: http://www.oecd.org/statsportal
EUROPEAN COMMISSION, Directorate general for "Health and Consumers", Food Safety: http://ec.europa.eu/food/plant
EUROPEAN COMMISSION, Directorate general "Environment", Sustainable Use of Pesticides: http://ec.europa.eu/environment/ppps
UK Pesticides Forum: http://www.pesticides.gov.uk/pesticides_forum_home.asp
Chemical Abstracts Service Registry Numbers: http://www.cas.org
Collaborative International Pesticides Analytical Council: http://www.cipac.org
Alan Wood Compendium of Pesticide Common Names: http://www.alanwood.net/pesticides

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